THE
AMERICAN
SURGEON

Subscription in the United States, $8.00

Vol. XVIII, No. 4 Copyright 1952 by
The American Surgeon Publishing Co. April, 1952

THE TRAINING OF A SURGEON

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"I have here gathered a posy of other men's flowers
and nothing but the thread that binds them is my own."
—*Montaigne*

IN September, 1949, undergraduate enrollment in the study of Medicine in the United States was listed by *The Journal of the American Medical Association* as 25,547. In addition, 4,125 doctors were engaged in graduate training in Surgery in approved hospitals.

The path to great achievement in any objective is, of necessity, marked by periods of contemplation when the effectiveness of current methods are evaluated and the worthy aims of the future are affirmed. By means of an annual inventory the business man evaluates his progress from year to year. In the vast project of training surgeons, a comparable method of evaluation along the way is likewise conducive to ideal, or near ideal, end results. Accordingly, an evaluation of the present day work of teachers of surgery and the finished product, the trained surgeon, is distinctly revealing when we consider:

1. What constitutes a "finished product" or "the ideal toward which we are contending."
2. The innate quality of the embryo product that is expected to develop to that "ideal toward which we are contending."
3. Means by which we are attempting to develop that "ideal."
4. What end results are being achieved.

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Presidential Address. Presented during the St. Louis Assembly of The Southwestern Surgical Congress, Sept. 24-26, 1951, St. Louis, Mo.

Only by sifting and winnowing the various discrediting elements from these four factors can we expect to bring to fruition that "ideal toward which we are contending."

The Teacher

What type of individual should be entrusted with the training of a surgeon?

Competent teachers in any branch of education are rare indeed and much more so in surgery. To be a scholar, or a surgeon, does not necessarily imply teaching ability. Doubtless there are great men in surgery who have lived lives of usefulness, have performed great feats toward the alleviation of suffering and yet do not have the essential talent for transmitting information to students. The teacher need not be responsible for outstanding advances and discoveries; this comes only to a few. He should, however, have a sense of pedagogy, if not actual training in that art. In the years past, which may well be called the "Golden Age" of surgical training, many of the great teachers acquired their pedagogic experience and knowledge in district schools, teaching students from kindergarten through the eighth grade. They knew pedagogy and they knew surgery and should you, who are concerned with the training of surgeons, ever find such a "rara avis," seize him and never let him go.

The successful teacher is also an individual of humility, that mark of greatness, in contrast to the intellectual arrogance characteristic of the ward-stalker with his retinue of awed students, interns and residents. Let it be remembered always that one does not "gain a point or impress an audience by unnecessary meaningless words" and often, "the man who talks the least, says the most." Also remember the statement: "I cannot hear your words for the thunder of your actions."

Must the teacher be a specialist in some particular division of surgery? I think not. Rather, his knowledge should include all the essentials of surgery. In addition, a sense of dramatics, properly applied, lends to the impressiveness of any speaker, even though, at times, it may be misleading. You will recall Osler's enthusiasm at finding a musician who was a victim of pulmonary emphysema. The later ascertained fact that the patient played the drums in the orchestra served only as an anticlimax and did not detract from the impressiveness of the lesson.

Must the teacher be full or part time? It is the belief of many, in which I assent, that the most valuable instruction comes from the individual in active practice whose experience from that fact

alone is increasing in its fullness. This, coupled with part time teaching which acts as a stimulus to study and keeping abreast of progress, increases his usefulness as an instructor twofold. The full time instructor in most instances has not the advantage of these situations.

Above all, the teacher should have the ability to create an atmosphere of mutual endeavor; to narrow the space of five or six feet between bench and rostrum and to inspire thought on the part of the student. Also, surgery has need of philosophers and dreamers as well as artisans. A unique personality difficult to describe though easily recognizable attends the successful teacher of surgery. It must be remembered that "greatness of the hand is greatness of the hour," whereas, "greatness of the heart will live for generations."

The Curriculum

In the past 25 years, so great has been the advances in surgery that it is impossible to follow any standardized practices in teaching. Training should, therefore, be concentrated on the fundamentals. Undoubtedly, more time should be devoted to anatomy than to nuclear physics. Anatomy and physiology have, from ancient times, been divorced. It is predicted that they will be reunited in the happy and better days to come. Structure and function are too intimate in their relationship to be forever separated. Likewise, their first-born, the twins of gross and microscopic pathology, should complete the family picture. Furthermore, the amount of time devoted to certain phases of subjects would appear to need revision, especially so when it is realized that in some curricula the time devoted to the chemistry of nucleo-proteins is 18 times greater than that devoted to visceral pain. Also, each specialist is constantly striving to cut an ever larger slice of the intellectual pie for his specialty. May God forbid the arrival of the day when the tetralogy of Fallot will receive as much attention as inguinal hernia in our curricula.

The preponderance of time in the last two years of medical school can be devoted most efficaciously to on-the-ward teaching, which allows freedom of exchange of instructor-student ideas and viewpoints and practical demonstrations with supervised student-patient contact. To separate the patient and student has been proved a defect of clinical teaching. In many schools an ideal plan is effected by having junior students work with inpatients and seniors with outpatients. Surprisingly, however, either through obstinacy, penury, or lack of foresight, a number of medical schools still cling

to lectures. In the training of students, the obligation to determine how he thinks can be more readily accomplished by on-the-ward teaching and by individual quizzing. The old pedagogic principle, "It is better to have a wrong thought on a subject than no thought at all," is not erroneous.

The Student

In the development of a surgeon, may we now consider the student as the raw material. Evaluating the quality of this raw material, we have, to begin with, a summation of elementary, high school and university education, resulting in an academic degree. Before the student is eligible to enter the preclinical courses, consisting of the basic sciences, he must pass the "screening" or "aptitude" tests by demonstrating qualities or characteristics of a foundation indicative of a successful physician. Now—by what test or criterion can these "qualities or characteristics" indicative of a suitable background for a successful doctor of medicine be ascertained? Certainly in the long process of training a surgeon we cannot afford the luxury of "square pegs in round holes." Are these "suitable qualities or characteristics" inherent? Can we say that the offspring of a successful surgeon will likewise be successful as a surgeon? As has been proved in many instances, unfortunately, the answer is "No." Yet, many students are permitted to study medicine on such a superficial foundation.

Many teachers of surgery believe that a good foundation in the knowledge of physics, chemistry and biology, coupled with native intelligence is an adequate foundation for the study of medicine. Granted that the foundation in physics, chemistry and biology (the latter described by Moynihan as "the interstitial tissue of surgery") is adequate, what then is "native intelligence?"

What about the individual with a record of having invented a time-saving mechanical device, the painter of works of art, the builder of houses and the master of details in oil-well drilling? Do not all of these demonstrate native intelligence? Can any one or all of these demonstrations of native intelligence be considered evidence of "qualities or characteristics" indicative of a successful doctor?

To me, the problem at this stage in the training of a surgeon is to achieve a more accurate means of revealing native intelligence capable of forming habits of thought. It is my sincere belief that during undergraduate training, any student lacking in aptitude and talent who does not respond to encouragement by sympathetic teachers, should be effectively eliminated from medical school by

the end of the second year.

From undergraduate study, the new doctors go to graduate training as interns and residents. At this point in the process of training a surgeon, certain discrediting factors begin to unveil. The medical school faculty has no control of what constitutes adequate training for interns and residents. This matter is completely controlled by organizations which are neither educational institutions nor licensing bodies. Hospital graduate training programs are set up to meet the dictatorial requirements of these self-governing bodies and in most instances, especially surgery, they cover a period of from five to six or more years. Postgraduate training is left principally to the discretion of the individual and in the case of the successful surgeon should, and does, continue the remainder of his active life.

"The Finished Product"

With the culmination of the foregoing factors, 12 years from his high school graduation, a surgeon is finally trained. A surgeon who is married, has a family of dependents, and an indebtedness to some one, state, nation or family of some $35,000. He has attained his goal. He has mounted the pinnacle he has viewed from the distance for 12 long years. He is now a *specialist,* equipped with highly specialized theoretical knowledge and mechanical skill, who must seek a location to practice in a city of sufficient size to maintain hospitals and connecting laboratories commensurate with his "ideally specialized" training and a population with pecuniary resources to support his practice on such a level. Without these, his pattern of practice is broken; the application of "specialized" principles must be supplanted by whatever, or how little, practical judgment and resourcefulness he may have been able to extract from his highly technical and specialized training. This product of 12 years of training can technically complete an operation with the dexterity of the bricklayer who constructs a wall. He is a *Diplomate of the Board* of whatever surgical specialty he may have chosen; but, is he able to distinguish and apply this "ideal training" in the less than ideal circumstances encountered in the daily life of every surgeon?

It has been my observation that one difference between the *capable* surgeon and the *incompetent* surgeon is that the capable surgeon is also a physician. It is not mere caprice that the name "physician" precedes that of "surgeon" on many doctors' nameplates throughout the land. A physician need not be a surgeon but a surgeon has great need of being a physician. The only difference between the two, after all, is the technic of therapy.

Of no less import is the economic security of this "finished product" of 12 years of training. With his long cherished title, "Diplomate of the American Board," his potential specialty practice must be drawn from the very small (15 per cent) of the population of his locality. This 15 per cent is further depleted by the boundaries of his particular specialty, after the patient makes his choice from the general practitioner, the general surgeon, the chest surgeon, the vascular surgeon, the plastic surgeon, the neurosurgeon, the cancer surgeon, or the foot surgeon. In spite of this, the *specialist* maintains it a breach of ethics to step over the line delineating his particular field. How many years ago was it that the old cliché about the "navel" surgeon was so popular?

The Cost

Someone, with unusual talent for numbers, although apparently not connected with the Bureau of Internal Revenue, has estimated that the capital investment of a surgeon, at the beginning of his practice, is between $35,000 and $40,000. To amortize this amount alone, the surgeon must pay an average of $1,081 per year between the ages of 28 and 55. In 1920, the cost of medical training was 20 per cent less than that of engineering. Now, it is 33 1/3 per cent more than engineering. In September, 1949, *The Journal of the American Medical Association* published figures showing that the annual cost of educating a medical student ranged from $567 to $2,252, or a median average of $1,662 per year. This cost, coupled with the cost of required graduate training of a specialist, clearly establishes the fact that medical training exceeds all other vocations and this cost along with many other commodities is constantly rising. The reason for this is explained, at least to a great extent by the following trends:

1. Full time instructors are replacing part time instructors.
2. Full time instructors in medical schools demand higher salaries than is necessary in other branches of education.
3. Growth and expansion of scientific knowledge.
4. Increase in hospital costs.

How can the increasing cost of medical training be met? Medical schools have four options:

1. Increased tuition.
2. Increased federal grants.
3. Increased philanthropic grants.
4. Increased State appropriations.

To increase tuition is to render medical training impossible for some of the most promising students. An increase in federal funds has been discussed repeatedly and the consensus prevails that to accept such is to hasten the complete loss of educational freedom and liberties. That federal subsidy is federal control is not disputed, a fact upheld by the Supreme Court of the United States. Further, federal bounty may become a burden. It seems indeed unfortunate that some medical schools have seen fit to invite such grants as evidenced by the action of the American Association of Medical Colleges. Private philanthropy is fast melting away. A continuation of the present tax laws will, no doubt, soon catalyze the process and the law of diminishing returns will prevail.

The remaining option, then, is an increase in state appropriations for medical schools. Many states have been fortunate indeed in this respect. As in Kansas and Oklahoma, far-seeing individuals of statesman-like qualities have studied the circumstances and influenced appropriations accordingly. On the other hand, medical education must not be permitted to become a captive branch of study, dependent upon state assistance alone for survival.

Deductions

Who can afford the time and the money involved for surgical training? Who can gamble on 12 years of financial future to the extent of $35,000 or $40,000 except a favored few of actual or potential affluence? Thus, fewer and fewer surgeons become available each year and the increasing cry of "under-supply" prevails.

The remedy usually offered for this under-supply is State Medicine. Can State Medicine more accurately "select" students with that "native ability" conducive to a successful surgeon? Can State Medicine reduce the cost of training or supply the cost in wholesale lots to all? Can politically controlled organizations develop a more adequate, more economical or shorter program for training competent surgeons? If so, can they institute and direct such a program at any smaller cost? The answer should be an emphatic and resounding "No."

I should not like to be regarded as a "scientific Olympian" sitting throughout the long night with a weary myopic eye at the peephole of an incubator, watching with derision the development of the embryo surgeon. Neither would I like to be marked as the confirmed, decrepit, pessimistic senile individual who is more interested in "where he has been" than "where he is going." I do, however, delight in being esteemed as a realist and it is in that light that I make the following conclusions.

Conclusions

In the training of medical students, except for convenience, surgical and medical cases need not be segregated. Some of us may live to see the day when we will walk into the pediatric, the adolescent, the adult or the senile wards instead of the medical or surgical wards.

The ideal ward rounds or bedside teaching is attended by the physiologist, the anatomist, the pathologist and the surgeon. Thus can the well named basic sciences be effectively correlated with surgery.

As a general rule too many professors are found on the clinical faculty in many schools. One particular surgical faculty, familiar to me, maintains 41 members, and of these 12 are assistant professors, three are associate professors, four are clinical professors and five are full professors.

Instead of the long years spent in review of the basic sciences and in graduate training to fulfill the requirements of the various educational organizations, would it not be more judicious as well as professionally effectual to (1) supply the increasing demand for doctors (2) reduce the educational cost and increase professional care by requiring the young doctor, after a minimum of two years graduate training (internship and residency) to spend a few years in general practice before completing his specialty training? This still young man would also be acquiring something to apply toward the much smaller training debt and, most of all, something more than the limitations of a surgical specialty, the consideration of the patient as a whole. The great state of Texas has made a forward step in this direction by giving intern credit for one year of supervised work in general practice.

Another important factor in the training of surgeons is the misuse of the laboratory. In spite of the fact that only 5 per cent of the diagnostic factors are found in laboratory procedures and 80 per cent of these are unnecessary, we are now in an age of laboratory debauch. As a result, the senses of the surgeon are undergoing atrophy and bedside diagnosis is fast becoming a lost science. Look upon the doctor who studies a chart for the first time. Does he turn to the laboratory reports first or does he spend a major part of his time studying the history?

The creation of great surgical associations will ultimately, if they have not already done so, destroy individuality and freedom of action of the surgeon. Too complete control of the young surgeon causes stagnation in his development. He becomes a mechanical

device, devoid of a surgical conscience, who does not hesitate to save a life only to cause another condition which makes life unbearable.

The name "Surgical Statesman" has been applied to leaders who have acquired great power. In general, power corrupts and the more absolute the power, the more absolute the corruption. The exemplary surgeon leads and guides; he does not control.

Our aim should always be to train students to be surgeons with a conscience—surgeons who strive to cure if possible and, when cure is impossible, to mitigate suffering and make every attempt to ease the ever present fear of death so that their patients may, with the serenity that accompanies faith and hope, enter that "vast night of forgetfulness."

UNUSUAL BONY REACTION TO A FAULTY INTRAMEDULLARY PIN

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The response of the body tissues to the introduction of irritating foreign bodies has been recognized and reported as such since the earliest of medical writings. Since the first reported use of metallic appliances for the internal fixation of fractures, almost every known metal and metallic alloy has been tried as a bony fixation device. With the introduction of modern aseptic technic and the use of certain alloys of stainless steel and the metal vitallium for internal fixation of fractures, local tissue response to such foreign agents has been reduced to the very minimum.

Extensive investigative work has been done in the past several years in regard to certain metals or alloys for the internal fixation of fractures. From such investigations it appears that the stainless steel alloy SMO 18-8 and the metal vitallium are practically inert in the body and provoke little, if any, irritative reactions in bones or in the soft tissues. With the use of these two types of metals for internal fixation, the occurrence of foreign body reaction to such metals is extremely unusual and when occurring probably represents local infection introduced at the time of operation rather than tissue reaction to the metal. Metallic appliances, pins, nails, and plates, made of either vitallium or SMO 18-8 stainless steel are available from any surgical supply house for general use at the present time.

The following case is reported because of the very marked local tissue response occurring following the use of a long Steinman pin used as an intramedullary nail for a fracture of the proximal third of the ulna. The Steinman pin used in this instance was selected from the regular hospital supply of such pins, which are supposed to be composed of the stainless steel alloy SMO 18-8. The pin selected in this instance was defective and apparently not composed of SMO 18-8 and it subsequently broke in its distal third with resultant very marked local tissue response in the lower half of the ulna. Several of such similar pins from the same supply have been used since this occurrence and no local reaction has been noticed, nor has there been any occurrence of similar breakage of any of these pins.

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Case Report

H. L. J., a 55 year old white male, sustained a severe Monteggia type of fracture of his right arm on Sept. 6, 1949, when he fell and landed very forcibly on his right elbow. He was seen by one of us (EBC) within two hours after the accident and admitted to Stuart Circle Hospital, Richmond, Va. Roentgenograms (fig. 1) revealed a dislocation of the head of the radius, and in addition, a comminuted fracture of the proximal third of the ulna, just distal to the olecranon process.

Fig. 1. A. P. and lateral roentgenograms on admission.

Open reduction of the fracture was done approximately six hours after injury. At operation, the articular surface of the head of the radius showed considerable subchondral hemorrhage and in addition there was a small chip fracture from the medial surface of the radial head. The dislocation of the radial head was reduced, following removal of the chip fracture, and the torn annular ligament was reapproximated. Following reduction of the dislocation of the radial head, the fragments of the ulna were in better position, but were found to be very unstable. A Steinman pin was inserted through the tip of the olecranon process, across the fracture site and into the medullary canal of the distal ulna fragment. This gave stability to the fracture fragments and maintained reduction of the radial head. Postoperatively, the arm was incorporated in a long arm plaster cast with the forearm and hand in neutral position. Roentgenograms (fig. 2) the following day showed what was felt to be satisfactory position of the fracture fragments of the ulna and reduction of the dislocated radial head. The patient was discharged on the fourth postoperative day, after a normal recovery. Approximately one week after operation, the patient reported that he felt a loud, snapping sensation in his arm. When the

Fig. 2. Lateral roentgenogram postoperatively showing Steinman pin in medullary cavity of ulna.

Fig. 3. Lateral roentgenogram at end of eight weeks showing distal fragment of broken Steinman pin. Note beginning marked periosteal and subcortical bony proliferation.

cast was removed on the fourteenth postoperative day, it was noted that the end of the Steinman pin projecting out of the tip of the olecranon process was very loose and could be freely moved. This had not been present at the time the pin was inserted. Roentgenograms at that time revealed the Steinman pin to have broken in the lower third and the distal end of the pin had migrated approximately 1 inch down the medullary shaft of the ulna. The fracture fragments of the ulna, however, were holding their position satisfactorily and the Steinman pin was not disturbed. The patient remained quite comfortable and the second cast was removed at the end of eight weeks. At that time the

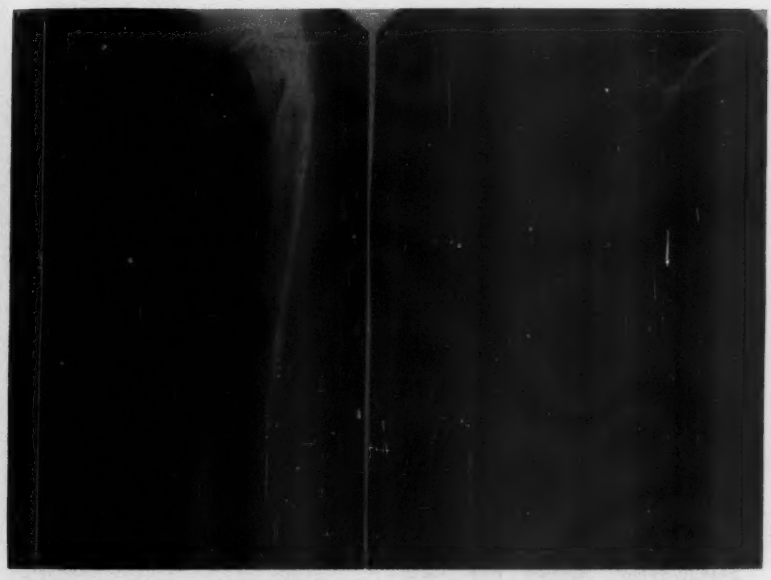

Fig. 4. A. P. and lateral roentgenograms of arm, one year following fracture and four months following removal of the fragment of Steinman pin.

proximal portion of the Steinman pin was freely movable and was removed, inasmuch as we felt it was not serving any immobilizing purpose. Roentgenograms (fig. 3) revealed the fracture of the ulna to be healing nicely. The distal portion of the Steinman pin was in the same position of the medullary canal as seen in the previous roentgenograms. There was very definite evidence of considerable cortical and periosteal reaction in the area of the ulna, overlying the fragment of the Steinman pin. The patient was started on active exercises to improve the rather marked limitation of motion present in the elbow and wrist. Motion of all joints of the right upper extremity slowly improved in the next several weeks. The patient returned to light work, as an iron foundry molder in February 1950, approximately 20 weeks after his injury.

He continued to complain of pain over the lower third of the ulna, particularly to pain on local pressure over this area. Roentgenograms of the arm on April 24, 1950, revealed a very marked increase in the amount and extent of periosteal and cortical proliferation in the lower ulna. In addition, there were areas of rarefaction present in the ulna cortex which had not been previously seen. It was now quite evident that the fragment of Steinman pin remaining in the medullary canal of the ulna was provoking this extensive tissue response. Inasmuch as the reaction was increasing and producing increased clinical symptoms in the patient, it was decided to remove this remaining portion of the pin. The patient was admitted to the Medical College of Virginia Hospital, Richmond, Va., on May 5, 1950, for removal of the pin. At operation, the periosteum was found to be tremendously thickened and in some areas measured ¼-inch in thickness. The underlying cortex was also very hyperplastic and could be easily cut with a dull osteotome. The con-

Fig. 5. Photomicrograph (X 240) of fragment of cortex of ulna removed at second operation. (Note: Subacute granulomatous reaction with many macrophages and foreign body giant cells.)

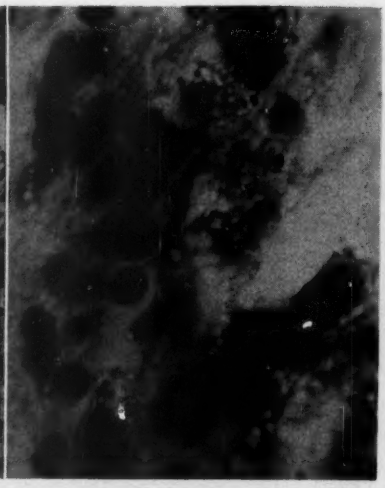

Fig. 6. Photomicrograph (X 1800) showing Hemosiderin, many large plasma cells and much cellular debris.

sistency of the cortex was soft and granular and grossly resembled bone which had been decalcified. A rectangular area, 2 inches by ½-inch of the ulna, overlying the fragment of the Steinman pin was fenestrated and the remaining portion of the pin easily removed through this window. The end surface of the pin, through the area that had broken, was rusty in appearance and after removal the pin itself was easily fragmented into three parts. The broken surfaces of the fragmented pin were also rusty and irregular in appearance. The fenestrated portion of cortex removed from the ulna was not replaced because of its soft granulomatous nature.

The patient returned to work two weeks after this operation. He no longer complained of pain over the involved area of the ulna and the range of motion of the wrist and particularly the last three fingers gradually increased in the next several weeks. Roentgenograms (fig. 4) on Oct. 31, 1950, four months after removal of the fragment of Steinman pin, showed some residual subperiosteal calcification on the radial surface of the ulna, but the extent and degree of periosteal and cortical thickening was greatly diminished. At that time the patient had returned to his former duties and was asymptomatic except for a limitation of extension of the elbow to 170 degrees and approximately 15 per cent residual limitation of motion of the right wrist.

Histological examination of the portion of the ulna cortex removed at operation revealed a subacute granulomatous reaction with many dead bone trabeculae surrounded by many large plasma cells and macrophages containing hemosiderin and much cellular detritus (fig. 5X 240 and fig. 6X 1800).

SUMMARY

A case of extensive local bony tissue response following the use of a defective Steinman pin as an intramedullary nail is reported. The pin used, unquestionably, was not composed of an alloy of stainless steel SMO 18-8. We are unable to explain how such a defective pin was included in the regular hospital supply of such pins, as previous and subsequent use of similar pins from the same supply have produced no untoward reactions. The fragments of the pin removed at the second operation were submitted to the manufacturer with the request that an analysis be made of the steel content of this pin. This manufacturer stated that the pin was of "stainless steel of approximately 400 series Rockwell hardness." The type of stainless steel in this particular pin was not stated in the reply from the manufacturer.

COLOSTOMY STOMA TUMORS

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IN REVIEWING the last decades of my studies and observations in the pathologic anatomy, including surgical pathology, of the intestinal tract, I was impressed by the rare occurrence of primary neoplastic growths at, and within the stoma of a surgical colostomy.

A study of the literature concerning tumors of the colostomy stoma does not reveal a pertinent discussion of this subject nor a presentation of such a case. In spite of many current books and excellent treatises on abdominal surgery, stoma tumors are not considered at all.

Let me present my observations.

CASE 1. A 67 year old male machinist was suffering from a carcinoma of the rectum. On Jan. 20, 1948, an abdomino-perineal resection was performed and an ulcerated tumor mass was found on the anterior wall of the rectum, 7 cm. above the anal ring, encircling the lumen. The tumor showed an axial length of 45 mm. A permanent colostomy was made in the left lower abdominal quadrant.

The microscopic examination disclosed an adenocarcinoma (grade III) without regional lymphoglandular metastases.

Three years later he was admitted to the hospital, this time because of bladder trouble—dribbling, nocturia and frequency. A large hypertrophic prostate, adenomatous cystic in structure, was removed by transurethral resection.

On this same occasion he stated that his colostomy opening is getting narrow and that the skin around it is "piling up." His family physician described it as an overgrowth of granulation tissue. On Feb. 2, 1951, a plastic operation was performed and the colostomy stoma together with the tumor was resected. The pathologic anatomic findings were as follows:

"In the immediate vicinity of the distal third of the round colostomy opening (fig. 1a) one finds an oval-shaped tumor (b) which causes a slight compression of the neighboring colonic mucosa. The tumor measures 22 mm. in horizontal direction and 15 mm. in width (cranio-caudally). It exhibits a nodular outer surface with a fine granular periphery (c), and projects 6 to 7 mm. above the skin level. The cut surface discloses a firm, white-gray tissue, which is sharply defined from the subjacent dermal structures. Laterally to the described large neoplasm, one notices a smaller tumor nodule, triangular in shape, 5.5 by 4 by 3 mm. in size, which exhibits identical gross appearance and structure as the main neoplastic growth.

"The entire colonic stoma is surrounded by a thin, somewhat raised linear scar, developed as a gray-white ring, and forms the boundary between the

Presented during the St. Louis Assembly of The Southwestern Surgical Congress, Sept. 24-26, 1951.

mucosal stoma and the adjoining skin of the abdominal wall. The cauliflower tumor seems to originate from the cutaneous scar.

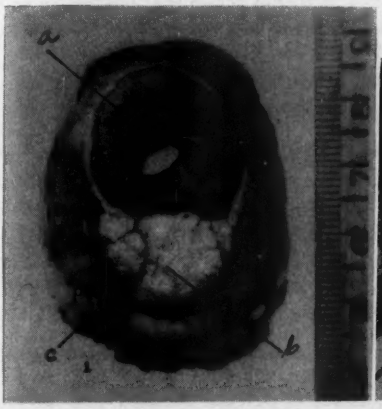

Fig. 1. Colostomy stoma (a), an oval shaped tumor (b) with nodular outer surface and granular appearance (c).

Fig. 2. Microscopic section of tumor shown in fig. 1, presenting a papillomatous structure.

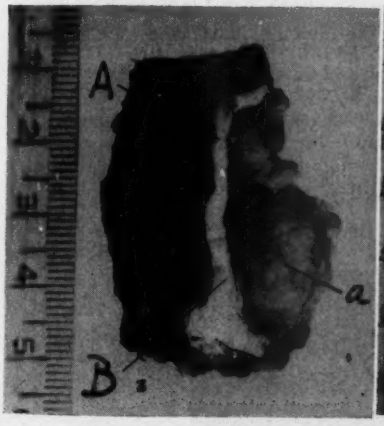

Fig. 3. Stoma tumor: normal strip of skin (a, b) surrounds the colostomy stoma, round nodule (a) protrudes through external opening of the stoma and colonic mucosa (c) covers the tumor nodule.

Fig. 4. Cut surface of tumor shows depressed scarred center (b); colonic mucosa (c) is fixed to the convexity of the neoplastic nodule.

"Microscopically (fig. 2) the tumor is composed of thick layers of regularly stratified squamous epithelium which does not invade the subjacent connective tissues. In places the papillae appear elongated and edematous but do not show any appreciable inflammatory reaction. They are accompanied by thin strands of epithelial downgrowth, of regular structure. The spinous layer is well developed while the stratum granulosum, the keratohyalin layer is only suggested and the surface keratinisation is slight. Small papillary outgrowths

are formed on the surface of the papilloma and they appear as minute branchings or buddings. In the center of the growth one notices a quite abundant downward extension of the thin elongated epithelial pegs at various angles and planes producing a netlike appearance of the growth in the depth of the tissues, resembling a plexiform fibro-papilloma (fig. 2).

Histogenetically, this tumor developed from the epidermis at the very margin of the colonic stoma and is classified as sessile papilloma of benign character. Papillomata of similar structure are not uncommonly found in the anal region, close to or at the anal opening, and are the result of constant irritation and repeated tissue traumatisms.

Analogous papillomatous neoplasms are encountered in other regions on the cutaneous surface of the body and on the inner lining of some hollow structures, for instance, in excretory urinary tract or upper respiratory passages. They often developed on account of long existing mechanical or chemical stimulations.

CASE 2. A 43 year old woman was operated upon (June 2, 1942) for a carcinoma of descending colon, which occurred at its distal end, close to the sigmoid boundary. The involved part of the bowel was resected, and an end to end anastomosis with complementary cecostomy was performed. She left the hospital 15 days later with undisturbed bowel function. We found in her history that her father and one sister died of cancer of the bowel. The microscopic examination of the resected tumor disclosed an adenocarcinoma (grade III), with limited extension through the muscular coats and an absence of lymph node involvement.

Four years later (March 28, 1946), a carcinoma of the rectum was removed (one stage abdomino-perineal excision), which was found on the latero-anterior wall of the rectum, at the upper margin of the rectal ampulla. The examined neoplastic tissue showed an adenocarcinomatous growth (grade III) without invasion of the perirectal areolar structures, and the lymph glands were free of tumor metastasis.

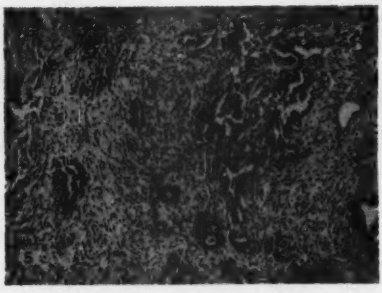

Fig. 5. Microscopic section of tumor shown in figs. 3, 4 reveals scirrhous adenocarcinoma.

During the subsequent three years the colostomy was in excellent condition and had been functioning daily. Recently, however, constipation and inability to expel stool appeared. The patient discovered a hard lump in the mouth of the colostomy, which previously had bled occasionally.

Physical examination (Feb. 25, 1949) revealed a slightly protruding, very hard round mass, 15 to 20 mm. in diameter, at the very opening of the colostomy with a superficial ulceration of one part of the mucosal margin. The skin was circularly incised around the stoma in order to mobilize the somewhat extruded colon, and the tumor together with the adjacent normal mucous membrane removed. Up to the present day a new neoplastic involvement of the colon mucosa has not appeared. The removed surgical specimen showed the following findings:

"The surgical colostomy stoma is 34 mm. in diameter and is encircled by normal appearing skin (fig. 3 a and b). One side of the stoma wall protrudes through the external opening and projects above the skin level for about 9 to 10 mm. in the form of a round, hard nodule (fig. 3 a) which is covered by the colonic mucous membrane (fig. 3 c).

The cut surface discloses a round neoplasm, 26 mm. in the longitudinal direction and 14 to 16 mm. in depth, presenting a depressed, scarred center (fig. 4 b). The upper part of the growth reaches the colonic mucous surface which is partly fixed to the convexity of the neoplastic nodule (fig. 4 e), while the lower part of the mucosa contains a superficial ulceration. The tumor tissue is dissected by fine, delicate, radially running white-gray streaks.

The microscopic examination (fig. 5) shows many irregularly growing carcinomatous tubules of varying size and shape, lined by tall and low cylindric epithelium, some of them exhibiting mucous secretion. They invade the intestinal muscular layer and are accompanied by strands of fibrous tissue (desmoplastic reaction) and by chronic inflammatory changes (fig. 5). According to the gross appearance and the morphologic structure, this neoplasm is an adenocarcinoma, partly scirrhous in character. It originated from the intestinal mucosa at the margin of the old colonic stoma.

This case confirms the old, well known observation of hereditary transmission of susceptibility of the colonic epithelium to undergo neoplastic changes with formation of malignant blastomatous growths. Not uncommonly we meet with a multiplicity of such autochtonous growths, developing synchronically or at irregular time intervals.

It should be emphasized that among the common complications of a permanent colostomy, such as cicatricial retraction and stenosis of the stoma, prolapse of the redundant, edematous colonic mucosa, development of benign and malignant neoplasms, though rare, should be added.

PAPILLARY THYROID CANCER ORIGINATING IN THE THYROGLOSSAL CYST

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WHEN one recounts the various indications for removal of a thyroglossal cyst, malignant degeneration is usually included. It was not until recently, when the author encountered a papillary adenocarcinoma of the thyroid in a thyroglossal cyst, that he was prompted to review the literature and found only 4 cases reported therein. It is difficult to understand why cancer is rare in the thyroglossal tract as thyroid tissue is commonly seen in both the tract and the cyst wall.[9,21]

A study of the embryology explains the occurrence of thyroid tissue in thyroglossal cysts. The tongue begins in the pharyngeal region and grows into the buccal cavity.[14] The first trace is a rounded elevation between the ventral ends of the first branchial arches. This is the tuberculum impar and forms the anterior two-thirds of the tongue. The posterior part of the tongue arises from the ventral ends of the second pair of branchial arches. The two parts of the tongue are separated by a V-shaped groove. A pouch-like depression develops below the angle of the V and thickens to form a mass. This is the beginning of the thyroid anlage (fig. 1). In a 2.6 mm. embryo the anlage may be seen growing down from the furcula[25] through tissue which later becomes hyoid bone. It branches to form the two lobes and isthmus of the thyroid gland (fig. 2). In the 6.5 mm. embryo, it is separated from the floor of the mouth, and the connecting strand usually disappears. With the downward growth there is a dragging of the epithelial elements from the pharynx, and the lining may be squamous or ciliated columnar. At the end of the first month of embryonic life the thyroglossal tract has a fairly straight direction. The hyoid bone presses against the tract which is not very elastic.[27] This divides it into two portions (fig. 3). Then as the hyoid bone grows, it divides the tract into an upper and lower anterior and a lower posterior portion. Thyroid tissue may be found along the strand or in the cyst wall. The amount of thyroid tissue in the tract usually stands in inverse relation to the normal development of the thyroid gland.

There are several types of lesions which may arise from a remnant of the tract. The cyst is the most common and may be found anywhere from the base of the tongue at the foramen cecum to the

Presented during the St. Louis Assembly of The Southwestern Surgical Congress, Sept. 24-26, 1951.

suprasternal notch. Due either to spontaneous rupture or surgical incision of an infected cyst, a sinus may be formed. The rupture may be at the base of the tongue or on the skin of the neck. Some of these rupture to either side of the midline. This explains the

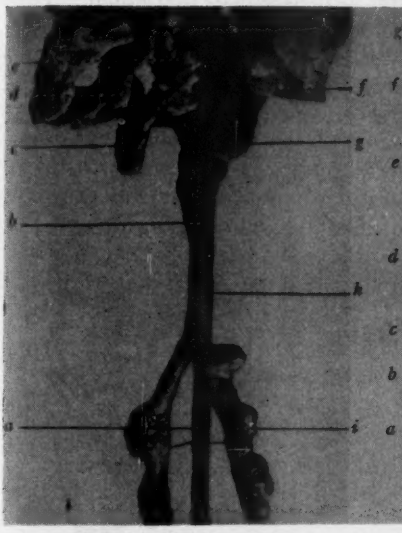

Fig. 1. Model of esophageal lumen and branchial apparatus of a 6.5 mm. embryo. Model straightened for greater clearness (Wenglowski) a—Esophagus. b—Trachea. c—Lateral thyroid lobes. d—Thymus anlage. e—Mid-thyroid anlage. f—Thymus anlage. g—Lateral thyroid anlage. h—Esophagus. i—Left lung anlage.

Fig. 2. Model of pharynx, esophagus, trachea and organs developing from them in a 14 mm. embryo. (Wenglowski) a—Thymus. b—Esophagus. c—Thymus duct. d—Mid-Thyroid lobe. e—Lateral thyroid lobe. f—Thymus duct. g—Pharynx. h—Thyroglossal tract. i—Thymus duct. k—Lateral thyroid lobe duct. l—Lateral thyroid lobe. m—Thymus lobe. n—Trachea. o—Thymus.

lateral position of some sinuses. Surgical incision likewise may cause lateral openings. Some authors feel that the infection is secondary to lymphoid tissue in the wall of the cyst; the lymphoid tissue becomes invaded by bacteria secondary to infections about the head and neck. It then spreads to the lining of the cyst or tract. Others feel that the reaction is chemical. True fistulas have been reported but are exceedingly rare due to the pressure of the developing hyoid bone with the resultant distortion of the tract. The entire thyroid gland may remain in the base of the tongue (lingual thyroid) or anywhere along the tract. It may undergo all the histologic changes seen in a normally placed thyroid. The lingual thyroid is not rare.[30,44] Last, there are solid tumors which may be adenomata or carcinoma. These develop from the thyroid rests along the tract.

These last two may enlarge rapidly and interfere with phonation, respiration, deglutition, and at puberty may cause menstrual disturbances.

As seen by the accompanying illustration (fig. 4), cysts may be at any point from the foramen cecum to the suprasternal notch.[3] They may be (1) at the foramen cecum at the base of the tongue, (2) in the floor of the mouth—the so-called lingual dermoid, (3) above the hyoid bone, (4) below the hyoid bone, (5) at the level of thyroid cartilage, (6) at the level of cricoid cartilage, or (7) at the suprasternal fossae.

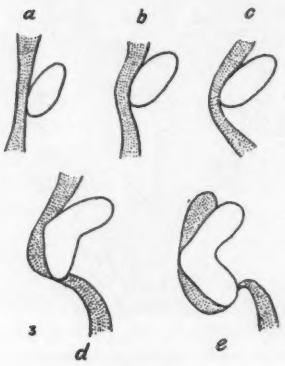

Fig. 3. Diagrammatic sketch of relationship between thyroglossal tract and growth of hyoid bone. Stages of development of hyoid and consequent division of tract (Wenglowski).

Fig. 4. Locations of cyst. 1. Foramen cecum. 2. Floor of the mouth—the so-called lingual dermoid. 3. Suprahyoid. 4. Subhyoid. 5. At the level of the thyroid cartilage. 6. Level of cricoid cartilage. 7. Suprasternal fossa.

The cysts vary markedly in size. As an aid to diagnosis, some authors advise injecting the sinus or cyst with a radiopaque substance and taking a roentgenogram. Parsons[32] reported a case with a submental opening in the midline, and lipiodol was injected to show the course of the tract. There may be no symptoms and the patient's only complaint may be the unsightliness of the mass. If the mass is in the base of the tongue, the patient may have difficulty in speaking, mastication, and deglutination. If the cyst presses on the thyrohyoid membrane, the patient may have a choking sensation, difficulty in swallowing or breathing. The fistula or sinus usually has an offensive discharge. In the differential diagnosis (fig. 5) one must rule out both infection and other tumors.[13,16,26] Acute suppurative or nonsupportive submental adenitis offers no

difficulty because the origin of the infection is usually obvious, and the attachment to the hyoid bone cannot be demonstrated. Tuberculous nodes are firm and matted. The discharge from these is usually purulent and not mucoid or milky as in a thyroglossal sinus. Branchiogenic cysts and sinuses are lateral and the tract can be traced in a lateral direction. Lipomas are unusual in this location, are usually lobulated, soft and nonfluctuant. Dermoids and sebaceous (epidermal) cyst may offer some difficulty, and the diagnosis may be made only at surgery. (Dermoids do not move on swallowing.) Hygromas are usually translucent and lobulated. They are frequently compressible; their location is usually lateral. Hemangiomas will decrease in size on pressure and are discolored. Aberrant thyroids may be lingual, suprahyoid, or infrahyoid in location. If this represents all the thyroid tissue of the patient, the removal may be followed by myxedema.

DIFFERENTIAL DIAGNOSIS

1. Acute suppurative or nonsuppurative submental adenitis.
2. Tuberculous nodes.
3. Branchiogenic cysts.
4. Lipomas.
5. Dermoids.
6. Sebaceous (epidermal) cysts.
7. Hygroma.
8. Hemangioma.
9. Aberrant thyroid.

Fig. 5

These abnormalities may occur at any period in life, but are more common between the ages of 10 and 30 years. They are found in both sexes, and there seems to be no predominance in either sex. Various reports, however, show marked variation.

The wall may be lined with ciliated columnar or squamous cells or both.[17] If infection has been present, the lining may be absent. Basement membranes may be more or less distinct and sometimes there is a muscularis mucosa. The wall is composed of fibrous connective tissue with small patches of lymphoid cells. The capsule may contain serous or mucous glands or thyroid alveoli. Sinuses may have slitlike or irregular branched side pockets extending several millimeters into the adjacent tissues.[36] They usually have mucoid content, but if the lining is squamous, it may be yellow grumous or pasty material.[16] It may contain epithelial cells, leukocytes and cholesterin.[35] Osteomyelitis of the hyoid bone was reported by Cattell in 1 case.

Malignant tumors of the thyroglossal tract are rare. A review

of the English literature revealed only 4 cases: 1 adenosarcoma, 1 adenocarcinoma, 1 epidermoid carcinoma, and 1 in which the type is not stated. Spencer[42,43] cited a case reported by Brentano.[7] This

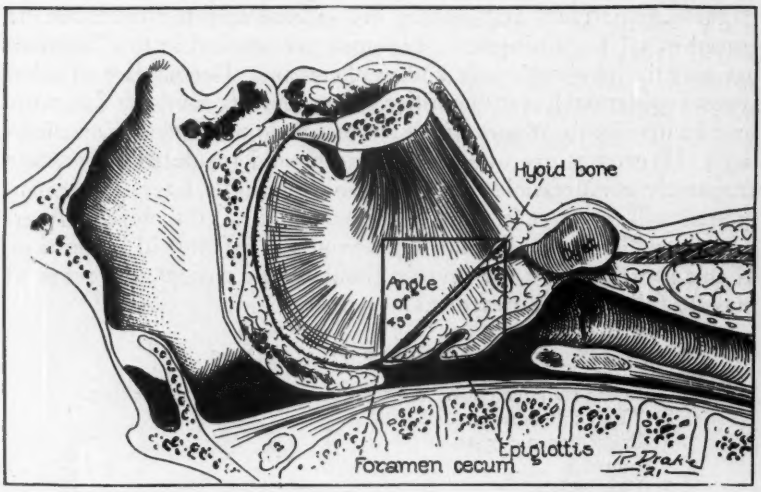

Fig. 6. Diagrammatic sketch showing course of the tract through the tongue. The angle of 45 degrees which this tract makes with the hyoid bone is demonstrated.

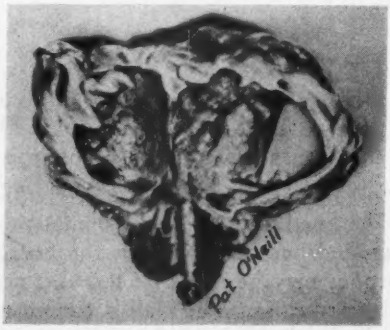

Fig. 7. Artist's sketch of specimen. On cross section the cyst had a wall measuring 1 mm. in thickness. The wall was smooth and glistening on its inner surface, except posteriorly where a yellow papillomatous granular growth arose and occupied roughly one-half of the lumen.

occurred in a 42 year old woman with a normal thyroid gland. A small tumor was removed from the base of the tongue nine years before. It was stated that not all of the tumor was removed. Two years later enlarged glands were excised from the right submaxillary region. Later there was a recurrence at the root of the tongue and

in the right submaxillary gland and in the left neck. A large mass was removed from the left neck, two nodules the size of hazelnuts from the right and a nodule the size of a small walnut from the base

Fig. 8. X 17. The lower portion of the section is adjacent uninvolved thyroid. Upper portion shows a part of the cyst wall with a nearly circular mass of papillary tumor tissue imbedded in the fibrous stroma of the wall. Other parts show a rather irregular infiltration of low grade papillary cancer.

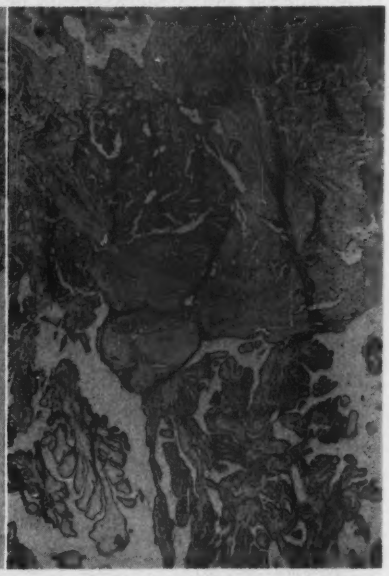

Fig. 9. X 30. Section shows another area of the cyst wall with a slightly different pattern of papillary neoplastic tissue similar to papillary cancer which occurs in the thyroid proper.

of the tongue. All showed thyroid tissue. Mayo[24] reported an adenosarcoma in a male aged 18 years. Clinically it was a "blood tumor" at the base of the tongue next to the epiglottis. Clute and Cattel[9] reported a case in a 6 year old boy with an early adenocarcinoma in a cyst. This was an incidental finding at surgery. Clute and Smith,[10] in a report of thyroid carcinoma, advance the theory that epidermoid carcinoma of the thyroid probably arises in the thyroglossal tract. The case here reported is a papillary cystadenocarcinoma of the thyroid in a thyroglossal cyst.

Case Report

The patient was a white female, aged 48 years, first seen on Aug. 19, 1949, with a history of a swelling in her neck of one year's duration. Another physician took a roentgenogram of her neck and told her she had a thyroglossal cyst. No treatment was advised. For the month previous to her first visit, it had enlarged fairly rapidly. She noticed a popping in her left ear when she

swallowed and a choking sensation. She went to another physician who suggested its immediate removal. Past history revealed that in 1936 she was told that she had a goiter and was given iodine by a physician. Careful questioning failed to elicit any of the symptoms of hyperthyroidism.

Fig. 10. X 100. Higher power view of papillations.

Fig. 11. X 100. The infiltrating epithelium tends to be of the columnar type. It shows moderate irregularity in size, shape, and staining qualities of nuclei. Mitotic figures occur with considerable frequency, and fairly numerous enlarged hyperchromatic nuclei are present. In places the tumor forms fairly good glands, but in other areas the organization is very poor.

Examination revealed a white female of the stated age. Her physical examination was negative except for the findings in her neck. Laryngeal mirror examination revealed a normal base of the tongue and larynx with normal movements of the vocal cords. There was minimal edema of the mucosa over the arytenoid cartilage. Some fullness was noted in the region of the thyrohyoid membrane. In the midline of the neck firmly attached to the hyoid bone was a mass 3½ by 2½ by 2½ cm. which was hard and seemed nodular with what appeared to be a small nodule anteriorly. It was attached to the hyoid bone and moved upward on swallowing.

A diagnosis of thyroglossal cyst with possible tumor formation was made. At the time of surgery the anesthesiologist noted a bulge at the base of the tongue, and edema of the arytenoid area. He experienced some difficulty in introducing his intratracheal tube. The method suggested by Sistrunk was followed in removing the tumor (fig. 6).[40,41] A transverse incision was made over the tumor mass. The skin subcutaneous tissue and platysma was divided and reflected. The sternohyoid muscles were separated and the tumor freed

up to the hyoid bone. The pyramidal lobe of the thyroid was seen coming up and going to the posterior part of the cyst separated by a small strand of muscle. This was divided about 5 mm. below the cyst. The central portion of the hyoid bone was removed, and the cyst was then dissected off the thyrohyoid membrane and the base of the epiglottis. It separated the muscles of the base of the tongue for a short distance, and these were removed with the specimen. During the operation the question of malignant degeneration was discussed because of the nodular feel of the tumor and the many lymph nodes. Muscle was left attached to the specimen in order to make the excision more adequate if carcinoma were present. After the specimen had been removed, the muscles were pulled together with fine cotton. The cut ends of the hyoid were not sutured together. Platysma and skin were closed in layers with interrupted No. 100 cotton.

Grossly the specimen consisted of a cystic mass which measured 3.5 cm. in diameter with attached muscle and a portion of the hyoid bone measuring 1.6 cm. It was fluctuant and contained a bloody fluid. On cross section it was found to be a cyst which had a wall measuring 1 mm. in thickness. The wall was smooth and glistening on its inner surface, except posteriorly where a yellow papillomatous granular growth arose and occupied roughly one-half of the lumen (fig. 7). Attached to the inferior border of the cyst was a nodule 5 mm. in size which grossly was thyroid tissue. The papillomatous growth arose from a very short broad base. Microscopic diagnosis was (1) chronically inflamed thyroglossal duct cyst, (2) papillary cystadenocarcinoma intermediate grade (figs. 8, 9, 10, 11).

The patient did well postoperatively and on Oct. 7, 1949, was given 200 mc. of iodine 131 at 2:10 p.m. At 4:25 p.m., the percentage uptake was 21. No uptake could be detected over the sternum, anterior chest or the right or left lateral neck or scar, using shielded tubes. At 8:40 a.m. on October 8 she had 35.9 per cent uptake. There was no uptake over any areas except over the thyroid itself. She excreted only 200 cc. of urine with iodine excretion of 11.6 per cent. As this represented the high level of normal for iodine uptake, it was assumed that the patient had a normal amount of thyroid tissue. As this tumor was making colloid, it was felt that it should take up iodine, and this would be a method of determining any local or metastatic residual disease. The test was done at this time to give us a base line for further examination should the question of recurrence arise. The bulge and edema in the hypopharynx have disappeared.

SUMMARY

One additional case of malignant degeneration of a thyroglossal duct cyst is presented, and the literature is reviewed.

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DERMAL GRAFTS IN THE REPAIR OF MASSIVE ABDOMINAL HERNIAS

Use of a New Split-Split Flap Technic

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Simple repairs of massive abdominal hernias are unsatisfactory. Frequent failures have led to the use of reinforcing material such as metallic plates and filigrees, fascia, whole skin, and dermis. Of these, the dermal graft appears to be particularly well suited to the purpose.

Following McGlannan,[1] the term "massive" is used here to include only those hernias having a ring not less than 40 cm. in circumference, or a capacity of 500 cc. or more. The term "dermis" (or cutis) is used to designate the deeper layer of the skin from which the epidermal covering has been stripped by any one of a variety of methods. Although the keratinized layer and adjoining epithelial elements are removed, some epithelial elements of sebaceous and sudoriferous glands, and hair follicles, remain in the dermis.

Historical Review

Dermal (cutis) grafts were first used by Otto Loewe in 1913,[2] when he reported 6 cases including 4 inguinal herniorrhaphies, 1 umbilical herniorrhaphy and 1 tendon repair. By 1929 he[3] had extended his observations to the clinical use of dermal grafts in almost 100 cases, with favorable results in most of them. He also made microscopic studies of a biopsy specimen of a dermal graft implanted during a previous operation and noted that the tissue showed retrogression of sweat and sebaceous glands without cyst formation.

Peer and Paddock[4] in 1937 made a more extensive histologic study in which they stored pieces of dermis beneath the skin in a series of plastic reconstructive operations and recovered them later after varying intervals of from one week to one year after operation. The dermal grafts were prepared by taking a full thickness graft and then shaving off the superficial epidermis with a scalpel. The dermis was then laid beneath the skin of the chest with the superficial layer outermost. They did not obtain true dermal grafts, however, but stated that "in spite of attempted complete removal

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Presented during the St. Louis Assembly of The Southwestern Surgical Congress, Sept. 24-26, 1951.

of the epidermis, some epidermis remained." The remaining epidermis gave rise to microscopic closed cysts containing horny material and fragments of hair. Sebaceous glands were noted only in implants up to one week's duration, hair follicles only up to three weeks, while sweat glands were noted in transplants up to a year in various stages of degeneration and fibrous replacement. The dermis survived by fusion with the adjacent subcutaneous tissue by the mechanism of inflammation and repair associated with aseptic wound healing. These studies were invaluable since they showed that the epithelial elements underwent spontaneous regression, but since these dermal implants were inlaid in the tissues and not sutured under tension, there was no influence of stress to promote metaplasia as was prominently noted by others who had opportunity to reexamine dermal grafts which had been operatively placed under tension.

Uihlein[5] in 1939 reported a study on the dermal grafts of two patients in whom grafts had been implanted under tension four years previously. Microscopically normal connective tissue with its fibrous and fatty components containing their own blood and nerve supply was noted. The abundant vascularity of the tissues was thought to be striking and no scar tissue was present. No hair follicles or glandular tissue was evident and there were no macroscopic or microscopic cysts present. However, he did note the presence of large cells with clear deeply staining nuclei lying in rings or rows which were thought to represent the remnants of hair follicles or glands. Uihlein reported 104 operations with dermal grafts done since 1938 and 80 of these were for hernia. There was a 15 per cent incidence of wound infection, but 9 of these ended in a good result with only 4 having a poor result and the result being unknown in 2 cases.

Cannaday[6] introduced dermal grafts in this country in 1942. He first reported 14 cases, but subsequently in a published personal communication to Harkins[7] stated he had done 107 operations with 56 hernia repairs.

In 1945 Mair[8] introduced the use of whole human skin in hernia repair and subsequently in 1948 reported repairing 140 indirect inguinal hernias by the whole skin graft technic with a recurrence rate of 0.7 per cent after a follow-up of one year and 40 direct inguinal hernias without a recurrence at the end of three years. Fifteen umbilical hernias were performed by this technic and 3 of these were complicated by sepsis. In 1 of these cases the infection was slight, but in 2 the sepsis persisted for approximately three weeks.

Mair[9] did work on the histology of whole skin grafts using the rabbit as the experimental animal. A full thickness skin graft was sutured under tension into a surgically excised fascial defect and the area was closed. Subsequently, sections were taken from the various animals at periodic intervals of from 1 to 238 days postoperatively. Macroscopically within 48 hours of implantation, the graft became covered by a thin film of exudate and the amount of this increased up to the end of the second week. By the end of the third week the entire area of the graft and its immediate surroundings was overlaid by a thick fluid and a slight swelling of the wound with increase in the local temperature was sometimes noted. In the majority of clinical cases a similar appearance had changed to a normal wound by the end of the third week. In the rabbit the graft had developed firm connections with its bed and surroundings by the end of the third week. By the end of six weeks there was no trace of any exudate and the graft was firmly anchored to its surroundings with the margin blending imperceptibly into adjoining tissue. Microscopically an aseptic necrosis with desquamation of the epidermis was evident within 48 hours of implantation. Aseptic necrosis was also detected in the deep layers of the dermis. Within a few days an inflammatory exudate surrounded the graft and by one week the dermis became infiltrated with an exudate of neutrophiles and fibroblasts. By the end of the second week atrophy of the hair follicles, sebaceous and sweat glands was noted. During the third week giant cells were seen in relation to hair follicles and sutures. The collagen fibers of the dermis persisted during this stage and granulation tissue attached the graft to its surroundings. Within four weeks characteristic phagocytic foamy cells were seen in a number of specimens. At three to four months the graft resembled cellular connective tissue with occasional small fragments of hairs encapsulated by fibrous tissue. Within five months the sebaceous glands, hair follicles, and epidermis had entirely disappeared. Biopsy specimens after six months revealed less cellular reaction than in earlier grafts. No cyst formation was noted either grossly or microscopically when the graft had been sutured tightly, but when the graft was left lying loosely, small pinhead cysts containing pultaceous material were seen in a clinical case 18 months after surgery, but no referable symptoms were present.

In only 1 other case has a cyst been noted and this was present three years after surgery and was described as being the size of a "cherry stone." The rarity of either microscopic or macroscopic cysts in any of the cases is noteworthy and serves to emphasize the importance of suturing the graft under tension. Two reexplorations of clinical cases were also reported. The first of these was

three months postoperative and histologic study of a biopsy specimen revealed highly vascular connective tissue in which no dermal or epidermal elements could be identified. There was firm adhesion to the underlying muscle. No hair remnants were identified and there was no trace of even microscopic cysts. In the second case, a laparotomy, done through a previous hernia repair revealed the graft to have blended with normal rectus sheath. The graft showed no trace of former epidermal elements and no giant cell formation. It was less vascular than the graft studied in the third month and consisted of strong connective tissue. There was no trace of cyst formation.

Advantages

1. Dermal grafts have many advantages. They are available in any quantity, size, or shape needed, whereas the source of fascia is limited. In 1 personal case, 64 square inches of dermis was easily obtained by the split-split flap dermatome technic and used to advantage.

2. A dermal graft repair is strong and stable from the time of operation, permitting early ambulation on the first postoperative day. The absence of reaction of dermis as compared to whole thickness skin also makes for a better postoperative course. Evidence of this was reported by Strahan[10] who, in a large series of 413 whole skin grafts in hernia repair, noted that he felt it necessary to keep the patients on strict bed rest for three weeks after operation because of "the considerable reaction noted in most cases up to well over two weeks." The preliminary removal of the cornified superficial epithelium from the dermis obviates the reaction caused by the inevitable necrosis of this layer and thereby early fusion of both upper and lower surfaces of the graft to the surrounding surfaces is facilitated.

3. Dermis is exceedingly strong in all directions of pull in contradistinction to fascia where most of the strength is in the longitudinal direction of its fibers. The strength of the fascia is frequently also poor in the longitudinal plane due to the greater tendency for sutures to pull through when placed parallel to the fascial fibers. Therefore, dermis makes a repair that is stronger and more resistant to the impact of pressure or strain, and it is easier to handle and utilize because of its natural elasticity and multidirectional strength.

4. Dermis becomes more readily replaced by live connective tissue with blood vessel and nerve supply to form an integral living part of the abdominal wall. Eitel[11] in 1934 removed pieces of fascia and dermis at operation and did metabolic studies on them with

the Warburg technic and proved that dermis lives longer and is more active than fascia and is therefore more suitable for plastic repair.

5. Dermis has great vitality and is able to survive under adverse conditions. In a personal case, a 72 year old man pulled out an inflated Foley catheter on the first postoperative day after a dermal graft herniorrhaphy. Urine extravasated into the area of operation and a suprapubic cystostomy was necessitated. Secondary infection was kept to a minimum by simultaneous chemotherapy with penicillin, streytomycin, and aureomycin and the inguinal herniorrhaphy healed with good support. Seven months postoperatively a weakness at the midline cystostomy site was repaired by simple approximation of the edges and the inguinal area was explored at the same time. A firm fusion of both surfaces of the graft was present and there were no cysts present.

Technics

Dermal graft technics have varied since their introduction in 1913. Loewe's[2] method of obtaining a dermal graft was to remove the full thickness skin with a scalpel and then to scrape off the superficial epidermis with a razor. This gave a dermal graft which had an irregular upper and lower surface. The remaining tissue was sutured over the defect under tension and the donor site allowed to granulate and heal by secondary intention.

Rehn[12] first reported the use of dermal grafts for the repair of incisional hernia in 1914. Rehn's method of obtaining dermal grafts was an improvement and included removing a Thiersch graft from the thigh and then removing the dermal graft of desired size from the underlying site. The Thiersch graft was then resutured to the thigh. This method gave a dermal graft superior to that obtained by the Loewe method since at least the superior surface was uniform. Rehn also reported experiments on the use of dermis as insert grafts in the Achilles tendon of dogs. He noted that, under the influence of continual tension, a gradual degeneration of epithelial elements occurred and the tissue assumed the appearance and function of a normal tendon in about 10 weeks. When the same experiment was repeated with fascia, regeneration was slower and the repair less complete, thus demonstrating the superior power of metaplasia which dermis possesses.

In 1939 Uihlein[5] reported Rehn's further modification which was called the Turflugel method (double breasted vest). In this method the dermis is cut from a portion of the abdominal wall to be discarded as when doing an excision lipectomy in conjunction with the

herniorraphy. This eliminates closing a secondary donor site but has the objection that the skin is frequently striated and atrophic in these cases. In 1943 Swenson and Harkins[13] reported an improvement of Rehn's method in which the epidermis was cut off with a dermatome but the dermis was also removed with a scalpel.

In 1944[14] Scola reported the first method whereby a dermal graft was obtained of known and uniform thickness in which both surfaces of the dermis are smooth and regular. In this method a full thickness dermatome flap .040 to .050 inch was cut and one end left attached. Fresh glue was applied to both the dermatome and the skin flap and the epidermis was shaved off the full thickness flap at a depth of .008 inch beginning at the attached end. The free epidermis was then resutured over the donor site after the dermal flap was cut off for use in the hernia repair. Harkins in 1945 first used the method previously devised by Zintel[15] of resplitting split thickness grafts with the dermatome. Zintel had introduced the method as a means for increasing the yield of limited donor sites in patients with extensive burns. The dermatome skin graft was cut into two layers of equal thickness on the drum by resetting the blade. For adults the entire thickness was .020 to .028 inches and each of the split halves was .010 to .014 inches. In children the depth of the graft was limited to between .012 and .018 inch. When Harkins used Zintel's method for the preparation of dermal grafts he used a dermatome setting of .040 inches or more and the epidermis was cut off at a depth of .010 to .020 inches and then replaced and resutured on the donor area. This method also had the advantage of giving a uniform dermal graft in which both surfaces were smooth and regular and was performed without having to reapply glue to the dermatome or skin. Harkins reported the successful use of dermal grafts in 11 cases.

The present original technic of obtaining a dermal graft utilizes the resplitting of a skin flap by the dermatome and thus avoids the necessity of having to reapply dermatome glue as in the Scola technic. The presence of the superficial epithelial skin flap facilitates resuturing it on to the donor site as compared with the detached graft technic.

Split-Split Flap Dermal Graft Technic: The skin of the thigh is first prepared by washing with soap (phisoderm with G11) for three minutes and then followed by alcohol, ether, and tincture of zephiran. Ether is then used a second time to remove the zephiran. The drum is cleansed with ether and the blade set at 30 to 34 thousandths of an inch from the drum (17 notches counterclockwise on Padgett dermatome dials) for an adult and 22 thousandths of an inch for a child (11 notches counterclockwise). Dermatome glue is

then applied to both the donor site and the drum surface. An important point in this regard is to apply glue on the leading edge of the drum so that when the drum is placed on the donor site skin will overlap the starting edge of the drum. The glue is allowed to dry for five minutes initially and when the dermatome is first placed in contact with skin it is held in position for one minute before proceeding (fig. 1). Even strokes of the blade are then used and the skin flap is left attached at the end of the drum. The blade is then drawn back to within ¼ inch of the starting edge of the flap with

Fig. 1. Split-split flap dermatome technic illustrated. Dermis being held up as it is split from superficial epithelium.

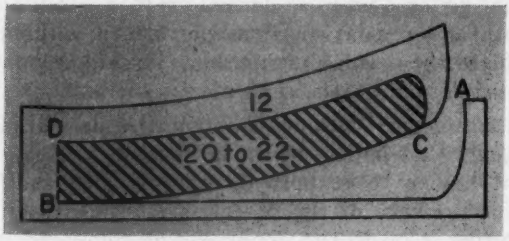

Fig. 2. Diagrammatic representation of full thickness skin with initial cut from A to B and resplitting from C to D. The base of the dermal graft (shaded area) is then cut off with the scissors (D to B) and the attached epidermal flap resutured.

care exercised not to draw the blade back over the edge of the flap. The knife is then lowered 10 to 12 thousandths of an inch from the drum in children and adults, respectively. In adults the Padgett dermatome dials are turned 11 notches clockwise to attain the lowering of 22 thousandths so the superficial epithelium will be 12 thousandths of an inch. Short, even strokes of the blade are used

to get started on recutting and cut down to the level of the previous split flap. The base of the inferior dermal flap is then cut off with scissors, leaving the base of the superficial epithelium attached. The technic is shown diagrammatically in figure 2. A warm saline pack is placed under the flap on the bleeding base for 5 to 10 minutes and the remaining three sides of the flap then resutured with 4-0 silk and furacin or xeroform ointment gauze and sterile fluffs and finally elastoplast is used to obtain a pressure dressing on the thigh. The dermal graft obtained by this technic is uniform in thickness and smooth on both surfaces. It is used as a reinforcement of a previously executed herniorrhaphy in which the structures are weakened and attenuated and are not thought to be adequate by themselves as shown in figure 3. In massive scrotal hernias, a

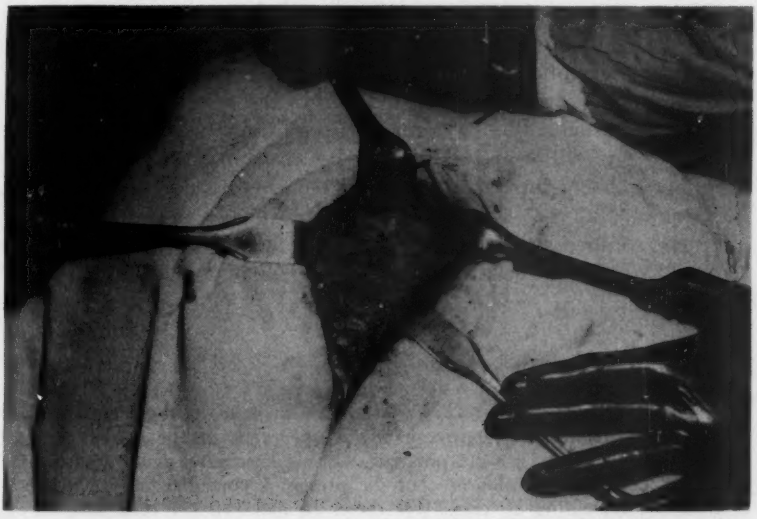

Fig. 3. Dermal graft shown as reinforcing layer over attenuated weakened deeper layer of repair.

Cooper ligament herniorrhaphy as advocated by McVay is first performed and if this is thought to need reinforcement, a dermal graft is sutured under tension upon the defect of the posterior wall of the canal. The graft is first sutured to the pubic tubercle and then upwards along the inguinal ligament. Medially the graft is sutured to the internal oblique. At the superior end the graft is split to allow for the emergence of the cord from the internal ring and the two tails of the graft are then re-approximated above the cord. This should fit snugly but not strangulate the cord. Multiple stitches are placed at scattered sites over the graft to assure a firm approximation to the underlying tissues. The aponeurosis of the

external oblique is approximated over the dermal graft and the cord is brought subcutaneously as in the Halsted herniorrhaphy.

In massive ventral hernias a transverse incision is most frequently used and as associated lipectomy is done in obese cases. Any old operative scars are excised if possible. The fascia is then dissected clean for at least one inch surrounding the hernia ring. Frequently the fascia and peritoneum are fused in a thin layer adjacent to the defect and an attempt to separate them for a closure in layers is unsatisfactory and further weakens the area. Therefore, the defect is usually closed in one layer from inside the sac with interrupted silk. After complete closure the excess peritoneum is excised and the short protruding edges of the sac approximated with interrupted silk to obtain a smooth closure. The dermal graft is then placed over the closure and at least one inch of the surrounding fascia, and sutured under tension, using interrupted silk sutures around the periphery. Additional interrupted sutures are placed through the surface of the graft to aid in the approximation to the underlying tissues. The subcutaneous tissues are then sutured down to the graft to obliterate all dead space, the skin closed and a sterile dressing with elastoplast applied for compression. The donor site is changed and the stitches removed on the seventh day, but an ointment compression dressing is maintained on the donor site for a period of three weeks postoperatively.

Case Reports

The initial case of dermal graft repair in the present series was done by turning a dermatome flap and then excising the dermis with a scalpel. The result of the hernia repair was satisfactory but, due to the irregular base obtained by this technic, approximately 25 per cent of the epithelial graft replaced on the donor site did not take. This necessitated pinch grafting the area and led to the development of the present reported technic which was used in the remaining 20 cases. Of these, 16 had 100 per cent take of the donor site and the remaining 4 had over 90 per cent take with the remaining small defects healing in a short time. All of the hernias reported were either massive sliding hernias or had incarcerated elements which prevented reduction and made satisfactory use of even a truss untenable. The age of the patients varied from 6 to 80 years. All of the patients were incapacitated by their hernias; 1 of them had been unable to walk for five years because of a ventral hernia which extended down almost to her knees (fig. 4). She was a 61 year old woman who had a long midline abdominal incisional hernia of 34 years' duration. The hernial ring measured 20 by 16 cm. in size and the sac contained the descending and sigmoid colon, omentum, and the greater portion of the small bowel. The patient did well and left the hospital on the tenth postoperative day, able to walk a few steps without assistance for the first time in five years. A preexisting uterine prolapse increased in degree postoperatively, however, probably because of the increased intra-abdominal pressure, so a vaginal hysterectomy was done four months later. Figure 5 shows the patient five months after the herniorrhaphy. The abdominal wall

has continued to remain well supported for over one year. All the other cases have also been followed for over one year except the last case of the series which has been followed for seven months. (Chart 1.)

Discussion: In none of the cases was any special or prolonged preparation of the donor site done as is necessary when full thickness skin is used. Penicillin was given routinely to all the cases and dihydrostreptomycin was at first given to every other case, but there were no infections in any of the cases. Three small subcutaneous hematomas and one scrotal hematoma occurred but these responded well to simple aspiration of the fluid. There was also one postoperative case of atelectasis and pneumonia which cleared rapidly. Tumefaction of the wound, reported by Zavaleta[16] as occurring in 20 to 30 per cent of the cases of full thickness skin implantation due to disintegration of the superficial epidermal layer, was not apparent in any of the present cases in which the superficial epidermis had been removed prior to implantation of the dermis. The occurrence of nonunion between the anterior or epithelial surface of whole skin and the subcutaneous tissues, due to the presence of keratolytic debris from the epithelial surface of the graft, as noted by Gray et al.[17] in the recent report on the fate of full thickness skin, was also avoided by the use of dermis.

Fig. 4. Preoperative massive abdominal hernia of 34 years' duration in a 61 year old woman.

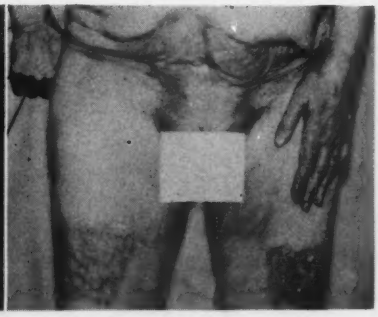

Fig. 5. Patient five months postoperatively showing well supported abdominal wall. Note healed donor sites on both thighs. Patient now ambulatory without aid after not being able to walk for five years because of the size of the hernia.

Early ambulation on the first or second postoperative day was used in all cases, and it was felt that this aided in the prevention of complications. In many of the cases of incarceration of large segments of bowel over a period of many years, the viscera had lost "their right of abdominal domain," but simple approximation of hernial edges without overlapping the fascia, Wangensteen suction, and early ambulation, aided in reestablishing normal bowel function and kept complications to a minimum.

Summary

1. A new method of obtaining dermal grafts by a split-split flap method is described.

CHART I. SUMMARY OF OPERATIONS

Case No.	Age	Sex	Type of Hernia	Size	Duration	Result	Follow-up Period	Comment
1	78	M	Inguinal sliding	Superimposition of internal and external rings 10. by 7. cm. defect	15 years	good	23 months	Large scrotal hernia extended two-thirds of way to knees.
2	72	M	Inguinal recurrent	5. cm. internal ring	4 years	good	21 months	Satisfactory result despite extravasation of urine into operative site.
3	25	M	Inguinal sliding	7. cm.	4 years	good	21 months	
4	76	M	Inguinal sliding	4. cm. internal ring	1 year	good	20 months	Sigmoid colon and small bowel in scrotum.
5	60	F	Incisional, RUQ—followed previous cholecystostomy	10. by 18. cm.	26 years	good	19 months	Cholecystectomy through hernial ring and herniorrhaphy done at same operation.
6	61	F	Incisional midline infra-umbilical followed previous hysterectomy	8. by 13. cm.	4 years	good	19 months	Replacement of incarcerated sigmoid colon and cholecystectomy for acute gall-bladder done through hernial ring.
7	61	M	Inguinal, small bowel incarcerated in scrotal position	6. cm.	3 years	good		Died of chronic leukemia four months postoperatively.

CHART I—Continued

Case No.	Age	Sex	Type of Hernia	Size	Result	Follow-up Period	Duration	Comment
8	58	M	Incisional, rt. upper quadrant (Exploratory laparotomy)	15. cm.	3 years	good	15 months	Healed well despite advanced portal cirrhosis.
9	40	M	Incisional, Left upper quadrant (Exploratory laparotomy)	18. by 13. cm.	1½ years	good	12 months	Paraesophageal hernia also repaired through hernial ring.
10	80	F	Incisional, RUQ (cholecystostomy)	11. by 12. cm.	16 years	Died on 11th postoperative day from spontaneous rupture of aneurysm of right internal carotid artery		Cholecystectomy and common duct exploration done through hernial ring for calculous biliary obstruction with deep jaundice. (Prothrombin normal.)
11	56	F	Incisional, infra-umbilical (hysterectomy)	10. cm.	12 years	good	12 months	Cholecystectomy for calculous gallbladder also done through hernial ring.
12	64	M	Inguinal sliding	7. cm.	16 years	good	14 months	Scrotum containing sigmoid, small bowel, and omentum extended half way to patient's knees.
13	53	M	Incisional, RLQ (appendiceal abscess)	18. by 10 cm.	2½ years	fair	13 months	Excision of superficial sinus necessary after secondary infection of incised sterile subcutaneous hematoma. Repair remains well supported.

CHART I—Continued

Case No.	Age	Sex	Type of Hernia	Size	Result	Follow-up Period	Duration	Comment
14	40	M	Bilateral direct and indirect inguinal. Incarcerated small bowel in rt. side of scrotum	6. cm (right)	17 years	good	12 months	
15	45	F	Incisional, RLQ (appendiceal abscess)	10. cm.	28 years	good	14 months	
16	6	F	Congenital omphalocele	5. cm.	6 years	good	13 months	Small bowel and incarcerated omentum in thin omphalocele sac.
17	74	M	Incisional, RUQ (old colostomy site)	9. by 5. cm.	4 months	good	13 months	
18	56	F	Incisional, Low midline (hysterectomy)	15. by 5. cm.	5 years	good	13 months	Contained incarcerated small bowel and omentum.
19	61	F	Incisional, Middle and lower abdomen (Appendiceal abscess)	20. by 16. cm.	34 years	good	12 months	Contained descending and sigmoid colon and greater portion of small bowel. Patient unable to walk for 5 years because of hernia extending between legs.
20	60	M	Incisional, LUQ	15. by 8. cm.	6 months	good	12 months	
21	47	M	Incisional, RUQ	8. by 5. cm.	3 years	good	7 months	

2. A series of massive abdominal hernias, including 13 ventral (incisional) hernias, 7 inguinal (scrotal) hernias, and 1 congenital ventral hernia (omphalocele) are described in which the split-split flap technic of dermal graft repair was used. There was one infection in the series which occurred secondarily after a small subcutaneous sterile serum cyst was mistakenly treated by partially reopening the incision instead of aspirating the fluid. All but 1 of the cases have been followed for over one year, and there has been no recurrence in any case. One death occurred due to the spontaneous rupture of an intracranial carotid aneurysm.

3. The advantages of the dermal graft technic of hernia repair include the availability of a strong reinforcing graft with multidirectional strength which is available in any quantity without any previous elaborate preparation of the donor site. The immediate strength of the repair and the rapid fusion of the graft make early ambulation and minimum hospitalization possible, even in massive abdominal hernia, making it a method of choice in these cases.

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MULTIPLE CANCERS OF THE ORAL CAVITY

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THE appearance of multiple cancers in the same or different organs is a well recognized phenomenon. Warren and Gates,[1] reviewing more than a thousand cancer autopsies, reported the incidence of multiple primary malignancies as 3.7 per cent. Furthermore, numerous observers[1,2,3,4,5] have established the fact that there is a greater susceptibility to cancer in persons already having one cancer than in the normal population. For example, Kilgore[4] has estimated the likelihood of a second breast cancer in the patient with one breast so involved to be 3 to 4 times that in the normal individual.

To supplement previously collected data,[3,6,7] a series of cases of cancer of the oral cavity has been evaluated to determine the following: (1) the incidence of multiple oral cancers, (2) the treatment of these lesions, and (3) their prognosis.

One hundred and sixty-six cases of major oral cavity cancers, including lip, tongue, buccal mucosa, palate, tonsil, and pharyngeal lesions, were reviewed. Some of these were hopelessly advanced cancers when first seen, and could be observed for only a short time. Others were followed for somewhat longer periods, but were lost because of the failure to cure the primary malignancy. A number were lost sight of for other reasons. Coexisting multicentric sites arising in a single area of leukoplakia, or contiguous lesions, were excluded. Despite these limitations, 20 (or 12 per cent of the total number) can be considered to have multiple cancers. Of these, 4 had two or more oral malignancies at the time of initial observation, while 16 developed their second and subsequent lesions at some time after the appearance of the initial carcinoma. The period of time varied from three weeks in case 20 to seven years in case 1. In all of these cancers, the initial and subsequent lesions were epidermoid carcinoma, varying only in the degree of differentiation.

Statistical data, showing location of lesions, time relationships, and survival status are outlined in table 1. It may be seen that 12 patients had two cancers each, 5 patients had three, and the remaining 3 had four lesions.

The etiology of the malignancies in most of these cases is unknown. However, in 4 of them, specific etiologic factors were

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present. In case 1, pernicious anemia, carelessly regulated, was a known factor in producing a chronically irritated mouth in which a second cancer developed one year after treatment of the first, a third 10 months after the second, and a fourth three years after the third—the fourth cancer being associated with bilateral servical metastases. In case 2, the patient had chewed tobacco for many years prior to the development of his first buccal mucosa cancer, and at the time of his initial treatment he had leukoplakia of the entire oral cavity. Case 12, when first seen, had widespread atrophic changes of the oral mucous membrane. Despite conservative therapy, multiple areas of malignancy appeared. In case 13, there was a history of untreated syphilis. In general, there was no constant factor to suggest any reason for the appearance of additional cancers after treatment of the first.

The cases in this group varied greatly in the location and extent of their involvement. A number presented multiple, small lesions which could be excised in toto without the production of local deformity requiring plastic reconstruction. On the other hand, some of the cancers were large, the removal of which made major reparative procedure necessary. Cases 1, 3, 7, 15, and 20 required neck dissections on the contralateral side in the treatment of the subsequent malignancy for proven metastases. Case 12 required multiple, massive intra-oral excisions plus jaw resections to control malignant areas developing in leukoplakia. In 3 cases, 11, 17, and 19, large areas of advanced cancer were present initially, requiring massive surgery which resulted in deformity of sufficient magnitude to require major reconstructive procedures.

The over-all cure rate in these patients with multiple lesions is considerably better than one would expect. Of the 20 patients, 13 are alive from 9 months to 25 years after treatment of their first cancers. Of these, 11 show no evidence of malignant disease, and 1 (case 1), while showing no cancer in the mouth, has a new primary carcinoma of the bladder. Of those patients not alive, 1 survived 16 years (case 3) with multiple tongue lesions, and another for nine years (case 2) with several cancers of the buccal mucosa and hard palate.

Discussion

One might assume that the appearance of a second malignant tumor would offer a dire prognosis. This is not necessarily so; in fact, the evidence from this group of cases would suggest that the individual patient who survives the first malignancy, if periodically observed and adequately treated, has a good chance of survival. There are several possible explanations for this. First, except in

No.	*Initial Lesion and Treatment*	*Subsequent Lesions and Treatment*	*Survival*	*Remarks*
1	(1) Soft palate (May 1942) ℞—Contact roentgen rays	(2) Uvula (April 1943) ℞—Excision		Had pernicious anemia
		(3) Anterior pillar (Jan. 1944) ℞—Excision and interstitial irradiation	9 yrs.—Alive	Now has cancer of bladder (July 1951)
		(4) Epiglottis (March 1947) ℞—Interstitial irradiation and bilateral complete neck dissection (proved metastases)		
2	(1) Buccal mucosa (1940) ℞—Excision of multiple lesions	(2) Hard palate (1946) ℞—Excision		Chewed tobacco
		(3) Buccal mucosa (July 1947) ℞—Excision, interstitial irradiation, and upper neck dissection (proved metastases)	9 yrs.—Dead	Simultaneous lesions (1)
3	(1) Tongue (Mar. 1933) ℞—Interstitial irradiation	(2) Tongue (Aug. 1939) ℞—Excision	16 yrs.—Dead	
		(3) Tongue (April 1946) ℞—Excision and bilateral complete neck dissection (proved metastasis)		
4	(1) Lower alveolus (June 1944) ℞—Excision and jaw resection, upper neck dissection (proved metastases)	(2) Upper alveolus (July 1946) ℞—Excision and lower neck dissection (proved metastases)	5 yrs.—Dead	
5	(1) Soft palate (July 1945) ℞—Interstitial irradiation	(2) Larynx (Aug. 1947) ℞—Roentgen rays to larynx and complete neck dissection (proved metastases)	?—Dead	Probably died in 1947
6	(1) Buccal mucosa (1926) ℞—Excision and complete neck dissection (no metastases)	(2) Buccal mucosa (Feb. 1937) ℞—Interstitial irradiation, excision, and jaw resection	25 yrs.—Alive	Free of malignancy (July 1951)
7	(1) Palate (1942) ℞—Excision	(2) Buccal mucosa (Oct. 1942) ℞—Excision, bilateral upper neck dissection (proved metastases) (1945), and left lower neck dissection (proved metastases) (1946)	9 yrs.—Alive	Free of malignancy (July 1951)
		(3) Buccal mucosa (Jan. 1950) ℞—Excision		

No.	*Initial Lesion and Treatment*	*Subsequent Lesions and Treatment*	*Survival*	*Remarks*
8	(1) Tongue and anterior pillar (Feb. 1947) Rx—Interstitial irradiation and complete neck dissection (proved metastases)	(2) Soft palate (Mar. 1950) Rx—Interstitial irradiation (3) Floor of mouth (July 1950) Rx—Excision	4 yrs.—Alive	Now has contralateral metastases (July 1951)
9	(1) Pharynx (1936) Rx—Excision and complete neck dissection (? metastases)	(2) Tongue and Pharynx (Jan. 1944) Rx—Roentgen rays to pharynx, interstitial irradiation to tongue, excision, and upper neck dissection (no metastases) (3) Buccal mucosa (Sept. 1944) Rx—Interstitial irradiation	9 yrs.—Dead	Died of recurrence in tongue
10	(1) Buccal mucosa (June 1941) Rx—Excision, upper neck dissection (proved metastases), and cauterization of mandible	(2) Alveolar ridge (opposite side) (Sept. 1942) Rx—Excision	10 yrs.—Alive	Free of malignancy (July 1951)
11	(1) Buccal mucosa and floor of mouth (July 1947) Rx—Excision, jaw resection and upper neck dissection (proved metastases)	(2) Buccal mucosa (opposite side) (Oct. 1949) Rx—Excision and upper neck dissection (opposite side) (no metastases)	4 yrs.—Alive	Free of malignancy (July 1951)
12	(1) Buccal mucosa (Dec. 1948) Rx—Excision, jaw resection and upper neck dissection (no metastases)	(2) Lower lip (April 1949) Rx—Excision (3) Buccal mucosa and tongue (June 1950) Rx—Excisions (4) Tongue (Jan. 1951) Rx—Excision	2½ yrs.—Alive	Simultaneous lesions (3) Free of malignancy (July 1951)
13	(1) Buccal mucosa and corner of mouth (Oct. 1948) Rx—Excisions	(2) Buccal mucosa and lower lip (May 1949) Rx—Excisions (3) Buccal mucosa (Feb. 1950) Rx—Cautery destruction (4) Upper lip (Oct. 1950) Rx—Excision	2½ yrs.—Alive	Initially had untreated syphilis Simultaneous lesions (1) (2) Free of malignancy (July 1951)

No.	*Initial Lesion and Treatment*	*Subsequent Lesions and Treatment*	*Survival*	*Remarks*
14	(1) Floor of mouth (one side) and floor of mouth and tongue (opposite side) (Oct. 1947) ℞—Interstitial irradiation		4 yrs.—Alive	Simultaneous lesions (1) Free of malignancy (July 1951)
15	(1) Tongue (May 1946) ℞—Interstitial irradiation and complete neck dissection (Jan. 1950) (proved metastases)	(2) Epiglottis, vocal cord and pharyngeal wall (July 1950) ℞—Excision, interstitial irradiation, and complete neck dissection (second side) (proved metastases)	5 yrs.—Dead	
16	(1) Buccal mucosa (July 1946) ℞—Excision and complete neck dissection (proved metastases)	(2) Lower lip (Sept. 1948) ℞—Interstitial irradiation	5 yrs.—Alive	Free of malignancy (July 1951)
17	(1) Buccal mucosa, lip, cheek, mandible (Aug. 1949) ℞—Excision, jaw resection, and complete neck dissection (proved metastases)	(2) Upper lip (Dec. 1951) ℞—Excision	2 yrs.—Alive	Free of malignancy (July 1951)
18	(1) Soft palate, larynx, tonsil (Oct. 1950) ℞—Interstitial irradiation and roentgen rays	(2) Tongue (Feb. 1951) ℞—Interstitial irradiation	9 mos.—Alive	Free of malignancy (July 1951)
19	(1) Lower lip and corner of mouth (1938) ℞—Excision, roentgen rays (1939) Radical excision, cauterization of mandible (1939), upper neck dissection (proved metastases) (1940)	(2) Lower lip (opposite side) (Feb. 1951) ℞—Excision	13 yrs.—Alive	Free of malignancy (July 1951)
20	(1) Larynx (April 1948) ℞—Laryngectomy and complete neck dissection (proved metastases)	(2) Tonsil (May 1948) ℞—Interstitial irradiation and complete neck dissection (second side) (proved metastases)	2 mos.—Dead	Possibly simultaneous lesions (1) (2) Died of lung abscesses not related to cancer

the case of simultaneous malignant lesions, the first malignancy must have been under control along with its metastases if present, for some period of time before the second one develops. In the absence of such control, one might expect the patient's death to antedate the appearance of another cancer. Second, presuming that the primary disease has been eradicated, common sense dictates a close follow-up for a long period of time despite the absence of signs or symptoms. Thus, a new malignancy will probably be found while it is young, and before it has had much chance to invade adjacent tissues or to metastasize. This is assuming that the subsequent lesion is not inherently more vicious than the first.

The problem of treatment may be reduced to that of treating each individual malignancy as it appears, not letting the patient's previous cancer history limit the adequacy of treatment. Lesions must be excised widely, and regional node dissections carried out when necessary. From the prophylactic standpoint, any specific etiologic factor, such as leukoplakia, other precancerous lesions, and sources of chronic irritation of the oral cavity should be removed and a good regime of mouth hygiene maintained. It is not sufficient to watch the patient with apparently cured oral cavity cancer for a period of three or five years. The evidence suggests that it is not exaggerating to say that he should be examined thoroughly at frequent intervals for the rest of his life.

SUMMARY

The problem of multiple intra-oral cancers has been reviewed. Twenty such cases have been presented and the results of treatment evaluated.

The principle of treating each primary and subsequent malignant lesion adequately, and without regard for the patient's previous cancer history, has been emphasized.

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INFLAMMATORY NEOPLASTIC LESIONS OF THE SMALL INTESTINE

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THE impetus given to the roentgenologic study of the small intestine by Bouslog,[1] Golden,[2] and Good[3] has brought into sharp focus disease entities of this previously neglected portion of the gastrointestinal tract. Nevertheless, too few lesions of the small intestine are diagnosed before operation or autopsy. The following review is a summary of our experience in treating 26 inflammatory and neoplastic conditions affecting the jejunum and ileum. Lesions proximal to the ligament of Treitz, congenital anomalies and their complications were considered not to be within the scope of this presentation.

Table 1 lists the cases encountered. There were 13 inflammatory, 7 benign and 6 malignant lesions of the series.

Regional Ileitis. According to Crohn,[4] "Regional ileitis is a nonspecific chronic recurrent granulomatous disease affecting mainly young adults and characterized by a necrotizing, ulcerating, inflammatory process. Cicatrizing elements in the long enduring cases is an important factor." Abdominal pain, diarrhea and a secondary anemia are the cardinal features of this disease. The patients usually have a low grade fever. The diagnosis can be made from the history. Frequently, an abdominal mass is discovered upon physical examination. Further confirmation of the diagnosis can be obtained by the roentgenographic recognition of the string sign. The string sign, according to Kantor[5] "is a thin, irregular, linear shadow suggesting a cotton string in appearance and extending more or less continuously from the region of the last visualized loop of the ileum through the entire extent of the filling defect and extending to the ileocecal valve."

The treatment of choice is resection of the involved ileum and the right side of the colon with end to end ileotransverse colostomy. Recurrences are common, usually because of failure to remove a sufficient segment of the diseased ileum.

CASE REPORTS

A 20 year old woman had suffered with mild diarrhea for three years. She had lost weight and had noticed abdominal pain for one year. Three months

Presented during the St. Louis Assembly of The Southwestern Surgical Congress, Sept. 24-26, 1951.

TABLE 1

1. INFLAMMATIONS	
Regional Ileitis	8
Tuberculosis	2
Diverticulitis	2
Periarteritis Nodosa	1
2. NEOPLASMS	
A. *Benign*	
Carcinoid	2
Endometrioma	2
Lymphangioma	1
Leiomyoma	1
Lipoma	1
B. *Malignant*	
Carcinoma	3
Carcinoma	2
Lymphoma	1
Total	26

before admission to our hospital she was subjected to a laparotomy for what simulated an attack of acute appendicitis. The surgeon discovered an inflamed and thickened distal ileum. He closed the abdomen. The pain and diarrhea persisted and the patient continued to run a low grade fever. She developed an acute intestinal obstruction the day before hospital admission. At operation a typical terminal ileitis was discovered. There were ileoileal, ileocecal and ileosigmoidal fistulas. A right hemicolectomy with resection of the distal ileum was performed. A primary closed end to end ileotransverse colostomy was carried out over a Rankin clamp. The patient's convalescence was uneventful and she has maintained a normal nutritional status since then.

Tuberculosis. Tuberculosis of the small intestine is usually a complication of pulmonary tuberculosis but it may occur in the absence of lung involvement as primary intestinal tuberculosis. It presents itself as either the ulcerative or hyperplastic form of the disease. The following case brings out interesting points in a case of the hyperplastic form of intestinal tuberculosis.

A 40 year old man had attacks of periumbilical pain for one year. Because of the severity of the attacks and the fact that the patient began to vomit with each episode of pain, roentgenograms were repeated on many occasions but never while he was having acute pain. During an especially severe period of pain the patient was admitted to the hospital. A scout roentgenogram showed the typical pattern of small bowel obstruction. On exploration the same day two granulomatous obstructing lesions were found in the mid-ileum (fig. 1). A wide segment of ileum was resected and a primary closed end to end ileoileostomy was performed over a Rankin clamp. Chest roentgenograms subsequent to this procedure revealed that the patient had active pulmonary tuberculosis. He has been put on a program to correct this condition.

Fig. 1. Photograph of resected intestine showing hyperplastic form of intestinal tuberculosis.

Diverticulitis. According to Golden,[2] acquired diverticula occur quite frequently in the jejunum. They may vary in size from less than one to several centimeters in diameter. He states that they are usually of no clinical significance. This condition was encountered two times in this series of cases. Figure 2 shows a specimen not recognized in the roentgenogram but discovered during a routine abdominal exploration. The following case is a complication secondary to diverticulitis of the jejunum.

A 70 year old woman was admitted to the hospital with excruciating ab-

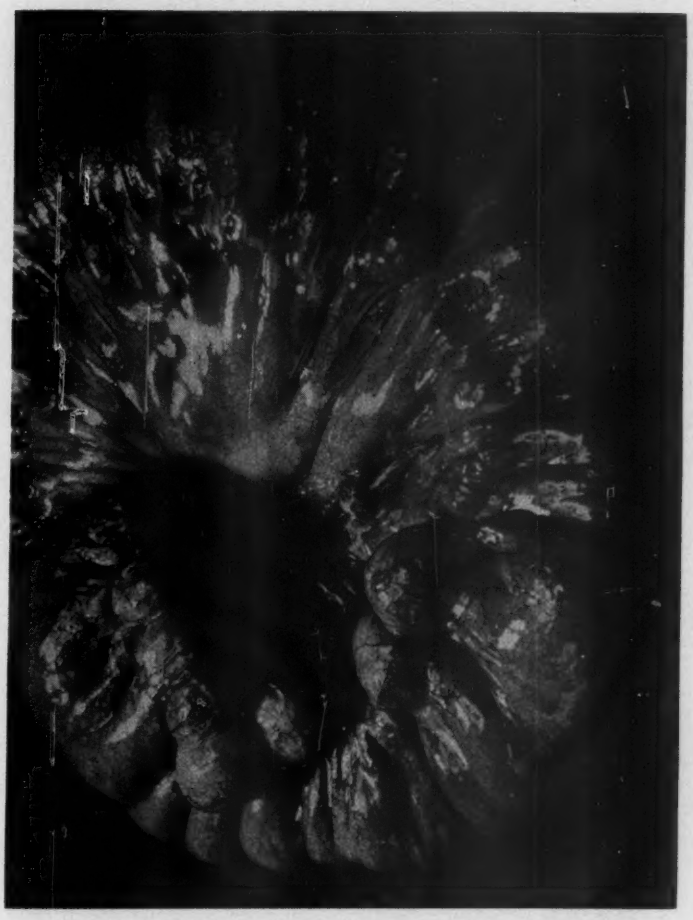

Fig. 2. Diverticulosis of jejunum discovered during routine exploration of the abdomen.

dominal pain. Physical examination was negative except for a distended and tender abdomen. Roentgenologic studies of the abdomen revealed the typical pattern of a strangulation obstruction. At operation a short time after the patient's admission a massive volvulus of the distal jejunum and the ileum was discovered (fig. 3). The axis of the volvulus was around an inflamed and perforated jejunal diverticulum. Ten and one-half feet of nonviable jejunum and ileum were resected and a closed end to end jejunoileostomy was carried out over a Rankin clamp. The patient has maintained a normal nutritional status since operation.

Periarteritis Nodosa. An interesting and unusual inflammatory lesion of the small intestine encountered quite by accident was a case

Fig. 3. Massive volvulus produced secondary to a perforated jejunal diverticulum.

of periarteritis nodosa. It is presented here to record the occurrence of periarteritis nodosa as a cause of an acute condition within the abdomen requiring surgery.[6]

A 63 year old man presented himself complaining of intermittent cramplike pain in the mid-abdomen. On physical examination the man appeared to be chronically ill. His abdomen was moderately distended and tender when palpated. The blood count was 18,400 leukocytes per cu. mm., 89 per cent of which were polymorphonuclear leukocytes. On opening the abdomen it was discovered that there were many small, dark purplish bands occurring segmentally throughout the entire small intestine. The serosa over these areas retained its normal smooth glistening appearance. One such band in the proximal ileum was adherent to the left peritoneal gutter. This segment of

Fig. 4. Typical photomicrograph from wall of intestine occurring in a case of periarteritis nodosa.

bowel was mobilized and at the site of the adhesion an indurated perforated ulcer was found on the antimesenteric border of the intestine. It was decided to remove only that portion of the bowel which included the perforation and two markedly discolored areas, 4 and 6 cm. from the ulcer. Accordingly about 16 cm. of bowel was resected and a primary open end to end anastomosis was performed. The patient's convalescence was stormy but he lived and was comfortable for 14 months following this procedure. Figure 4 shows a typical photomicrograph from the resected specimen.

Carcinoid. Of all the neoplasms carcinoid was the most common one encountered in this review. Two of these were benign and two malignant. This argentaffin staining tumor originates in the chro-

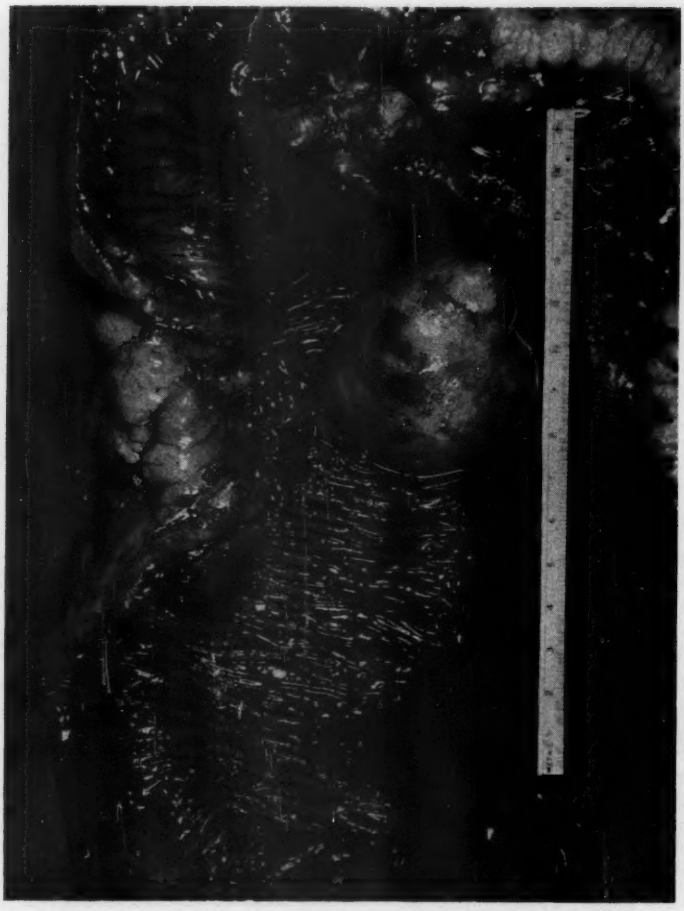

Fig. 5. Lipoma of the ileum. (Case report has been submitted to *A. M. A. Archives of Surgery* for publication.)

maffin cells in the crypts of Leiberkühn. It occurs most frequently in the appendix and second most prominently in the small intestine. Thirty-seven per cent of the reported intestinal lesions showed evidence of metastasis. The following case is typical:

A 38 year old woman had cramplike abdominal pain for six months. The pain had been accompanied by vomiting for one month. A routine gastrointestinal tract roentgenogram was nonrevealing. However, special studies of the small intestine demonstrated a persistent filling defect in the proximal ileum. At operation a firm yellowish tumor which partially obstructed the ileum was discovered. The adjacent mesentery and lymph nodes were enlarged

and firm. A generous segment of intestine together with the mesentery was excised and a primary end to end ileoileostomy was carried out over a Rankin clamp. The patient's immediate convalescence and progress to date has been uneventful.

Endometriosis. Endometriosis of the small intestine is not uncommon. It is, however, quite unusual for an endometrioma to reach a size sufficient to obstruct the small intestine. Two cases were encountered in this series. One is recorded here:

A 39 year old woman had always had severe dysmenorrhea. For one year the pain had persisted during and for one to three days following the menstrual period. She described it as feeling like "intestinal cramps." There was nausea but no vomiting. On physical examination nodulations were found in the cul-de-sac and a cystic mass was palpable in the right adnexal region. At exploration extensive pelvic endometriosis was discovered. A large chocolate cyst replaced the right ovary. The distal ileum appeared to be dilated. About 10 cm. proximal to the ileocecal valve a 4 cm. brownish cyst was found in the wall of the ileum. A right salpingo-oophorectomy and pre-sacral neurectomy was performed and the segment of ileum containing the cystic tumor was resected and an open end to end anastomosis was performed. The patient has been comfortable since operation.

Lymphangioma. A lymphangioma can occur any place in the body. The neck axilla and groin are the most common sites. The following case of lymphangioma involving the mid-ileum is briefly reviewed:

A 30 year old man was admitted to the hospital complaining of cramplike abdominal pain and vomiting. A distended and tender abdomen was found on physical examination. Scout films of the abdomen revealed the typical pattern of a mechanical type of intestinal obstruction. Operation was performed by Dr. Ray G. Witham. Distended and contracted loops of the small intestine were encountered. A large pale cystic tumor replaced and obstructed a segment of the mid-ileum. The tumor was filled with a milky fluid. It, together with a portion of the intestine, was resected and a primary open end to end ileoileostomy was performed. The patient recovered without complications.

Leiomyoma. Leiomyomas of the gastrointestinal tract are not unusual tumors. In instances of massive hemorrhage where no lesion exists in the stomach and duodenum and liver function tests are normal, a gastrointestinal tract leiomyoma is the most likely diagnosis.

This 38 year old woman had been perfectly well until she fainted in the bathroom. Shortly after this she passed a voluminous bright red stool. The patient complained of being extremely weak and was admitted to the hospital. Physical examination was nonrevealing except for extreme pallor. The erythrocyte count was 3,000,000 per cu. mm. and the hemoglobin was 6.5 Gm. per 100 cc. Blood urea nitrogen was 40 mg. per 100 cc. Bleeding from the bowel continued. The patient was given three transfusions of whole blood

500 cc. each. Her general condition and the laboratory findings were essentially the same on the following day. Exploration on an emergency basis was deemed advisable. At operation a firm, well demarcated tumor was found in the distal ileum. Because of the malignant potentialities of this lesion a wide segment of ileum proximal and distal to the tumor, together with the adjacent mesentery, was excised. Gastrointestinal continuity was reestablished by an open end to end anastomosis. The pathologist reported the tumor to be a leiomyoma and the patient recovered without incident.

Lipoma. One is impressed with the comparative infrequency of clinical lipomas of the gastrointestinal tract. Smith and Mayo found reports of 67 small bowel lipomas in the Mayo Clinic files and noted that 53 were subclinical, found only at necropsy. In their 9 cases in which the tumor produced symptoms intussusception was "the event that generally led to the diagnosis of lipoma." In the case outlined here the lipoma was intussuscepted into a carcinoma of the cecum.

A woman was referred complaining of shortness of breath and a swollen abdomen. The patient had noticed a gradual increase in the size of her abdomen for five years and found it necessary to take pills to keep her bowels moving. On physical examination a large tender mass seemed to fill the entire right side of the abdomen. Barium enema revealed what appeared to be an obstructing lesion at the hepatic flexure of the colon with distention of some loops of the small intestine. The abdominal viscera were displaced anteriorly and to the left side. At operation the distal ileum was found intussuscepted into the cecum. The head of the intussusception appeared to be an intraluminal mass. The mesentery proximal to this area was hemorrhagic. A firm mass was also palpable in the cecum. The distal ileum and right side of the colon were resected and a closed end to end ileotransverse colostomy was performed over a Rankin clamp. The pathologist found a lipoma 6 cm. in size 25 cm. proximal to the ileocecal valve, and a carcinoma of the cecum (fig. 5). The patient had recurrent attacks of diarrhea for six weeks but has now regained her normal weight and state of body nutrition.

Carcinoma. Carcinoma is the most common malignant tumor of the small intestine. The symptoms are usually related to perforation, bleeding or obstruction. Roentgenograms may be of value in diagnosing these tumors in one or a combination of three ways. First and most commonly, by revealing a narrowing of the intestinal lumen at the site of the lesion with compensating widening proximal to the obstruction. Second, by demonstrating a filling defect in the lumen of the bowel, and last, by furnishing presumptive evidence of small bowel pathology in cases having a typical history by excluding the presence of a lesion in the stomach or colon. A roentgenologic diagnosis was made in 2 of the 3 cases encountered in this review.

The patient, a 74 year old woman, complained of weakness and abdominal

distention of six months' duration. She had had an unexplained secondary anemia for one year. The patient began having what she called "bilious spells." At first these were rather infrequent and characterized by a feeling of discomfort in the upper abdomen and nausea and vomiting. It was noteworthy that the attacks always came on exactly one hour after eating one or another of the three daily meals. Her symptoms increased in frequency and severity. The patient developed an almost constant gurgling in the abdomen. An upper gastrointestinal roentgenogram made six weeks before admission was negative. Her symptoms persisted and she developed acute colicky upper abdominal pain. On the day of admission to the hospital roentgenologic studies were repeated, and the examiner advised immediate admission to the hospital because of impending jejunal obstruction. At operation a markedly distended jejunum was found proximal to a constricting tumor in the jejunum. A segment of intestine including the tumor and adjacent mesentery was resected and a primary closed jejuno-ileostomy was carried out over a Furness clamp.

Lymphoma. One case of lymphoma of the jejunum was encountered in this series. This condition is not especially rare.

A 40 year old man was admitted to the hospital with no complaints except that he had noticed a firm mass in the left upper quadrant of the abdomen which was increasing in size. This irregular fixed neoplasm could be easily palpated beneath the left costal margin. Roentgenograms of the chest and gastrointestinal tract were not helpful in making the diagnosis. Intravenous pyelograms were within normal limits. At operation a firm tumor mass involving the proximal jejunum and retroperitoneal lymph nodes was discovered. Frozen section of an excised portion of tissue revealed that the tumor was a lymphoma. The involved ileum and contiguous retroperitoneal lymph nodes were excised en bloc. An open end to end anastomosis was performed. The pathologist's report on the paraffin sections was "giant follicular lymphoma." The patient was subjected to massive doses of deep roentgenotherapy over four portals and has had no sign of recurrence for three years.

Conclusion

We have presented a series of 26 inflammatory and neoplastic lesions of the small intestine. From this experience our conclusions are:

1. Many pathologic conditions of the small intestine have a constant symptom pattern.

2. Any patient with unexplained diarrhea, intestinal bleeding or abdominal pain should be subjected to careful clinical and roentgenologic study of the small intestine.

3. Examination of the entire small intestine during routine laparotomy is worth while and frequently locates the pathologic conditon responsible for the patient's complaints.

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PLASTIC RECONSTRUCTION OF THE TRACHEA AND BRONCHI

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RESTORATION of the bronchial or tracheal lumen in the interest of preservation of lung tissue or life itself constitutes an intriguing challenge to the thoracic surgeon today. Injuries, tumors, tuberculosis, and other infections may compromise the lumen of these respiratory passages. Reliable reconstructive procedures are desirable to restore function and prolong life without unwarranted sacrifice of lung tissue.

Any tracheal or bronchial reconstructive procedure must meet certain requirements to be successful. (1) An adequate airway through a closed circuit must be maintained during the operation. (2) An adequate air-tight passage which is permanent without eventual stenosis should be obtained. (3) A fairly rigid, noncollapsible wall should be provided to serve as a scaffold for the regeneration of tracheobronchial epithelium. (4) Provision should be made for the ready removal of tracheobronchial secretions during the early postoperative period before the regenerating lining epithelium becomes functionally effective in this regard.

EXPERIMENTAL REVIEW

The surprising healing and regenerative powers of the trachea and bronchi have been well demonstrated experimentally. Complete healing without stenosis occurs in dogs after division or resection of segments of trachea or bronchus and end to end anastomosis.[1,2,3,4] The length of tracheal segment which can be removed and still permit an anastomosis varies from 2 to 5 cm. depending on the elasticity of the annular ligaments of the trachea, the mobility of the larynx and carina, and the position of the head and neck.[5,6]

Homogeneous tracheal transplants fail in the repair of defects in the dog due to absorption and nonreplacement of cartilage, leaving a flaccid, fibrous epithelium-lined tube that eventually produces stenosis.[1,2,7] On the other hand, autografts of segments of bronchus remain viable for complete healing without stenosis in the repair of large defects in the bronchus or trachea of the dog.[1]

Either main bronchus may be severed and successfully implanted

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Presented during the St. Louis Assembly of The Southwestern Surgical Congress, Sept. 24-26, 1951.

at a higher level in the trachea. Both main bronchi and the lower trachea may be resected and the airway reconstructed by performing an end to end anastomosis of the distal trachea to one of the main bronchi and reimplanting the other main bronchus higher on the trachea.[8]

Using various foreign substances such as glass, polyethylene, or stainless steel tubes, the tracheal airway may be reconstructed with regeneration of tracheal and bronchial elements including mucosa and cartilage around these rigid tubes without stenosis.[9,10]

Free fascial grafts, used to repair tracheobronchial defects in dogs, undergo connective tissue replacement forming an outer layer lined by pseudostratified epithelium with a layer of submucosa, mucous glands and a few small islands of cartilage.[11]

A tube of tantalum gauze used alone to replace the cervical trachea in dogs results in the gauze being covered by granulation tissue which later develops into a fibrous stricture with no epithelial covering.[2]

Clinical Review

End to end anastomosis of the trachea or bronchi in the human has been successfully achieved, the first apparently in 1884 reported by Kuester.[12,13,14] Abbott has reported the plastic reconstruction of the tracheobronchial lumen by means of transverse suture after resection of the tracheal wall, the carina and the contralateral bronchial wall in 4 patients undergoing pneumonectomy for carcinoma.

Tubes of various foreign substances including polyethylene, stainless steel, and vitallium have been used to reconstruct the trachea, with varying degrees of success, the failures being due to difficulty in raising secretions through the reconstructed area or lack of rigidity of the regenerated tracheal wall.[15,16,17,18]

The use of fascia or skin laid over stainless steel wire or tantalum mesh has been successful in effecting a satisfactory reconstruction after resection of long lengths of the trachea and bronchi.[6,20,21]

Gebauer[21] has demonstrated the superiority of wire-enforced dermal grafts for plastic reconstruction of the trachea and bronchi in 13 patients. Wire-enforced dermal grafts are advantageous because the dermis is readily available (from the patient's back) and it is thick, tough, pliable and elastic. It holds sutures well and does not tear as readily as fascia or pleura. It adheres to any surface quickly and forms an air-tight closure. With wire-enforcing, the graft acquires the necessary rigidity for the tracheal or bronchial wall. It provides a living scaffold for the ingrowth of lining epithe-

lium. A dermal graft in a bronchus has been found to survive with little change one year after its original application.

Case Reports

The author's personal experience with plastic reconstruction of the trachea and bronchi consists of the use of dermal grafts in 4 patients and end to end anastomosis or transverse suture in 2. The indications were traumatic bronchial occlusion (2), tracheal carcinoma (2), and tuberculous stricture (2). The first 3 cases have been reported in detail elsewhere[22,23] and will be reviewed briefly.

Case 1. C. M., a 22 year old oil field worker, sustained severe chest injury on May 27, 1949. While unloading heavy drill pipe from a truck, he slipped and fell, the heavy pipe rolling across his chest and neck. A severe tension pneumothorax on the right side and a mediastinal emphysema developed rapidly, necessitating an emergency mediastinotomy and pleural decompression. The lung expanded well, but about seven weeks later, it became evident that progressive atelectasis was occurring. Bronchoscopy and bronchography at this time revealed a complete occlusion of the right main bronchus at the level of the carina (fig. 1).

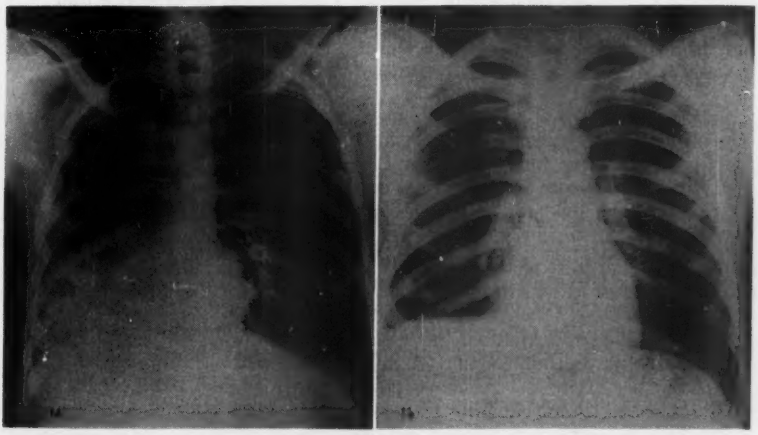

Fig. 1. Case 1. a. Roentgenograms illustrating partial atelectasis of the right lung and complete occlusion of the right main bronchus at the level of the carina. b. Complete expansion of the right lung one month following bronchoplasty by means of a dermal graft.

It was decided to attempt to save the patient's right lung by means of a plastic reconstruction of the right main bronchus. Accordingly, on July 2, 1949, a thoracotomy was done, the anesthetic being administered through an intratracheal tube inserted into the left main bronchus. The membranous portion of the lower trachea and the right main bronchus was incised, the incision being carried through the area of bronchial occlusion posteriorly. The mucosa was undermined for a short distance and sutured over the heavy, fibrous scar which formed the occlusion. An ovoid defect in the membranous portion of the lower trachea and upper bronchus remained. A dermal graft measuring

2 by 4 cm. was prepared from the skin of the back. The cut surface of the dermis was placed over the tracheobronchial defect and sutured in place by means of fine cotton sutures. Suture of the mediastinal pleura over the graft rendered the new wall air-tight to positive pressure.

The patient's postoperative course was uneventful. Early, complete re-expansion of the lung occurred, the patient leaving the hospital on the seventh postoperative day. The patient was re-examined one month later. Roentgenograms of the chest revealed complete expansion of the right lung and bronchography revealed a normal bronchial tree with no evidence of dilatation. Bronchoscopic examination revealed a patent right main bronchus with an intact normal mucosa. The only evidence of the previous occlusion was a narrowing of the bronchial lumen about ½ cm. distal to the carina. This narrowing is due to the scar in the bronchial wall medially and anteriorly which was not disturbed at the time of the plastic reconstruction. A 7 mm. Broyles bronchoscope could be readily passed through the area of narrowing.

The patient was seen intermittently for one year and has maintained lung expansion, with no evidence of further stenosis. He has had no cough, no wheeze and no dyspnea, and is working as a laborer.

Comment: A dermal graft was utilized satisfactorily to reconstruct the lumen of a bronchus occluded by trauma. Preservation of an entire lung in a functional state was thereby achieved. The narrowing of the bronchus produced by traumatic scar is not sufficient to interfere with normal function and has not progressed.

Case 2. W. H., a 56 year old man, was first seen in October 1945, at which time a pneumonectomy was done for an epidermoid carcinoma involving the right main bronchus and the mediastinal lymph nodes. The patient did well with no evidence of recurrence until July 1950, nearly five years later. At this time, he was seen with the complaints of cough, difficulty in raising secretions, blood spitting, a wheeze and shortness of breath. He had a stridor and evidence of a severe tracheal obstruction. A bronchoscopic examination revealed a fungating mass arising from the left lateral and anterior walls of the trachea about 5 cm. below the larynx and reducing the lumen at this point to about 3 mm. The carina was sharp and the right bronchial stump as well as the left main bronchus appeared normal. There was about 4 cm. of normal appearing trachea below the tumor. Biopsy specimens removed from the tumor revealed an epidermoid carcinoma.

On July 25, 1950, a portion of the left tracheal wall, measuring 3 by 5 cm. was resected, preserving the right posterolateral wall. A plastic reconstruction was accomplished utilizing a dermal graft laced with No. 32 steel wire and sutured to the margin of the remaining portion of trachea. The graft formed a fairly rigid wall, was air-tight, and provided an adequate lumen. A tracheotomy was not done at this time as it was believed that intratracheal aspirations, by means of a catheter would be sufficient for the removal of secretions. This proved to be a mistake in judgment, as it was necessary to perform a tracheotomy on the second postoperative day for the ready removal of tracheobronchial secretions. In spite of all measures to the contrary, the patient developed an atelectasis of the lower lobe of the left lung and died on the sixth postoperative day.

Autopsy revealed a bronchiolitis and atelectasis in the left lung. The dermal graft was intact and in good position (fig. 2).

Comment. In retrospect, a tracheotomy should have been done at the time of, or prior to, the reconstructive procedure. Frequent intratracheal aspirations were not sufficient for the removal of bronchial secretions. In the two days before a tracheotomy was done, the patient's one lung was already compromised by obstruction of the smaller bronchi. During the ensuing four days, the process could not be reversed.

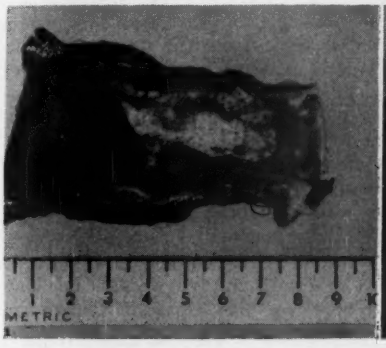

Fig. 2. Case 2. Specimen of trachea removed at necropsy illustrating the dermal graft in position.

Fig. 3. Case 3. Roentgenogram illustrating severe subglottic tracheal stenosis.

CASE 3: O. J., a 32 year old woman, was first seen in April 1950, at which time a severe granulomatous tracheobronchial tuberculosis was found beginning 2 cm. below the larynx and extending down the right side of the trachea and blocking the right main bronchus. The upper lobe of the right lung was atelectatic and there were scattered areas of infiltration in the remainder of the right lung. After six weeks of antimicrobial therapy (streptomycin and PAS), the granulomatous lesions in the trachea had disappeared although there was some narrowing. There was a severe stricture of the right main bronchus, the opening being pinpoint in size. On May 20, a right pneumonectomy was done. The postoperative course was uneventful except for the necessity of frequent intratracheal aspirations for the removal of secretions. The patient was discharged on the ninth postoperative day with instructions to continue antimicrobial therapy. She did well until September, when a stridor developed in the absence of cough. She was advised that a dermal graft to the trachea would be necessary. She was not seen until December 20, when she was taken to the hospital by ambulance because of marked shortness of breath. About one month previously, the patient had noted an increase in her stridor and a feeling of tracheal obstruction described as a "bubble in her throat." Exercise increased her difficulty. Her exercise tolerance progressively diminished so that she was unable to get out of bed. Roentgenograms and a bronchoscopic examination established the diagnosis of a severe subglottic stenosis (fig. 3) and slight narrowing of the lower trachea and left main bronchus. There was no evidence of active tracheobronchial tuberculosis.

On December 27 the strictured area in the trachea was incised posteriorly from the cricoid cartilage for a distance of 4 cm. to the base of the neck. A dermal graft threaded with No. 32 steel wire was applied to the defect, molded, and sutured in place. A tracheotomy was done.

The patient's postoperative course was stormy due to difficulty in maintaining an airway through the lower trachea and left main bronchus. Thick, bloody secretions and crusts formed around and below the tracheotomy tube. Repeated bronchoscopic aspirations through the tracheotomy opening were necessary until the third postoperative day. The tracheotomy tube was removed on the sixth postoperative day. Occasional intratracheal aspirations were necessary until the twelfth postoperative day. The patient's exercise tolerance improved remarkably, so that she was able to walk about the hospital with no stridor nor dyspnea. She was discharged from the hospital on the sixteenth postoperative day. One week later a wheeze developed, and the patient returned to the hospital. Bronchoscopic examination revealed no evidence of stricture nor narrowing in the upper portion of the trachea. The area of skin graft was smooth and appeared to be covered by normal glistening mucosa. Beginning at the level of the carina and extending into the left main bronchus there were masses of granulation tissue, beyond which in the left main bronchus gray tipped granulations were visualized, indicative of bronchial tuberculosis. The area was treated by direct applications of 30 per cent silver nitrate. Following this procedure, the wheeze disappeared and the patient returned home with instructions to return in two weeks. The day before her scheduled return, the wheeze recurred. She began the trip to the hospital immediately but on the way she suddenly died.

Comment: This patient developed a tracheal stenosis secondary to a tracheobronchial tuberculosis. A plastic reconstruction of the upper trachea by means of a dermal graft was successful. Bronchoscopic examination done a little over three weeks following the plastic reconstruction revealed a satisfactory mucosal lining. Complete relief of the tracheal stridor was obtained and the patient's exercise tolerance returned to normal before an obstruction in the left main bronchus developed. Repeated trauma to the lower trachea and left main bronchus during the early postoperative period, as a result of frequent bronchoscopic aspirations and the necessity for a tracheotomy tube undoubtedly wiped off or destroyed the thin bronchial mucosa and reactivated a previously quiesient bronchial tuberculosis. The bronchial tuberculosis eventually occluded the left main bronchus and caused the patient's death.

CASE 4. B.S., a 21 year old man, sustained a chest injury June 27, 1951, when he was struck by a drag line bucket. The left lung failed to expand. Seven weeks later a roentgenogram of the chest revealed a collapsed left lung, elevation of the left diaphragm, and a shift of the mediastinum to the left with overexpansion of the right lung (fig. 4). Bronchoscopic examination at this time revealed a complete block of the left main bronchus 1 cm. distal to the carina. A diagnosis of a traumatic bronchial rupture with healing by occlusion was made. On August 8 1951 the left main bronchus was reconstructed by an end to end anastomosis, resulting in complete expansion of the left lung. The bronchus had been completely ruptured, the two ends being separated by a distance of 1 cm., and each embedded in scar in the mediastinum. A bronchoscopic examination done on September 19 revealed good healing with no stricture formation.

Comment: As a result of trauma, this patient sustained a completely ruptured left main bronchus. An end to end anastomosis of the severed ends done seven weeks later resulted in complete expansion of the lung.

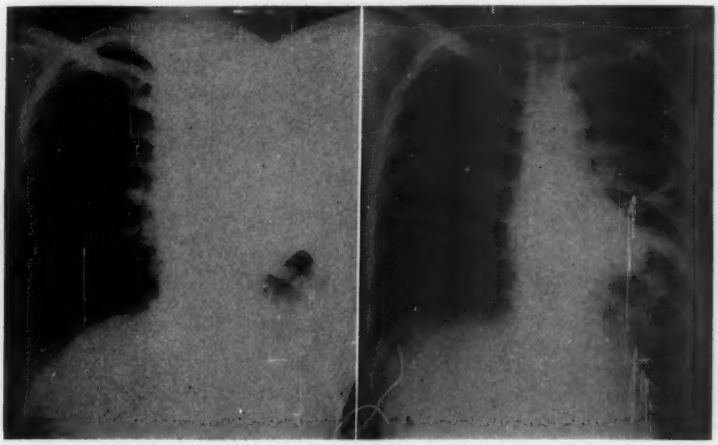

Fig. 4. Case 4. Roentgenograms illustrating: a. Atelectasis of the left lung, shift of the mediastinum to the left and elevation of the left diaphragm following traumatic occlusion of the left main bronchus. b. Complete expansion of the left lung following end to end anastomosis of the left main bronchus.

CASE 5. L. M., a 57 year old man, was operated upon on June 1, 1951, for a bronchiogenic carcinoma of the right main bronchus. During the operation the right middle and lower lobes were found to be airless and engorged with suppuration. There was extension of the carcinoma outside of the bronchus up to and involving the carina and the subcarinal lymph nodes. The paratracheal lymph nodes were likewise involved. A radical pneumonectomy was performed beginning in the paratracheal area. To provide a safe margin it was necessary to divide partially the trachea proximal to the carina removing the carina and a portion of the medial wall of the left main bronchus down to a point opposite the origin of the left upper lobe bronchus. A large defect resulted (fig. 5) which was closed by a transverse suture after the method described by Abbott.[19] The cut edge of the trachea was brought down and sutured to the cut end of the remaining portion of the left main bronchus. The suture line was covered by gelfoam and the cut ends of the azygos vein. It was air-tight. The patient's postoperative course was uneventful.

Three weeks later the patient developed a small leak at the site of anastomosis as evidenced by the expectoration of old blood and respiratory difficulty. The right pleural cavity was drained. With the assistance of streptokurase-streptodornase, all fluid was evacuated and the fistula healed.

The patient has remained well to date.

Comment: Resection of a portion of trachea, the carina, and the medial wall of the left main bronchus was necessary for the radical removal of a bronchiogenic carcinoma involving the right main bronchus, the carina and the trachea. An end to end anastomosis was done between the cut ends of the remaining portions of the trachea and the left main bronchus. Healing and a satisfactory result occurred with the exception that a temporary fistula developed three weeks later. The fistula healed with drainage of the pleural cavity.

*CASE 6. M. N., a 36 year old woman, was first seen on Nov. 15, 1950, when

*Case included through the courtesy of Dr. Robert R. Shaw.

Fig. 5. Case 5. Roentgenogram illustrating postoperative result following resection of a portion of trachea, the carina, and the medial wall of the left main bronchus and transverse suture.

Fig. 6. Case 6. Roentgenogram illustrating severe tracheal stricture.

a severe granulomatous tuberculous tracheobronchitis was found involving the right main bronchus, the lower trachea and the carina in addition to pulmonary tuberculosis of the right lung. The disease in the trachea and right main bronchus was treated with 30 per cent silver nitrate and antimicrobial therapy was prescribed. A second bronchoscopy done one month later revealed definite improvement in the appearance of the tracheobronchial lesion. A two stage, seven rib thoracoplasty was completed in January 1951. The area of disease in the lower trachea steadily improved although with healing the lumen became narrowed (fig. 6). The patient developed progressively increasing stridor and difficulty in raising secretions.

On June 27 a right pneumonectomy and a plastic reconstruction of the lower trachea were done. The cartilaginous rings of the lower 3 cm. of the trachea were destroyed. The membranous portion of the lower trachea was incised to a level opposite the first intact ring. A dermal graft threaded with No. 28 steel wire was sutured to the defect. The graft was air-tight immediately. A tracheotomy was not done until it was obviously necessary for the removal of secretions, on the second postoperative day. The patient improved steadily, and the tracheotomy tube was removed on the ninth postoperative day. The patient was discharged from the hospital on the fifteenth postoperative day with no stridor and was able to raise any secretions well. She has remained well to date.

Comment: This case illustrates the careful management of a severe tracheobronchial tuberculosis employing local treatment, thoracoplasty, pneumonectomy and a plastic reconstruction of the partially destroyed and strictured trachea by means of a dermal graft.

Discussion

Plastic reconstruction of the trachea or bronchi may be life-saving

or restore lung function. The method to be used depends on the type of lesion involved. Wire-enforced dermal grafts are satisfactory for the reconstruction in continuity of a strictured area. In the event of a resection of a limited segment of trachea (2 to 5 cm.) or bronchus, an end to end anastomosis may be accomplished. Should a more extensive resection be indicated, fascia or dermis used in conjunction with either steel wire or tantalum gauze may be employed to reconstruct long lengths of trachea. Rigid tubes of foreign substances used alone are not satisfactory. The fascia or dermis provides a scaffold for the ingrowth of tracheobronchial epithelium.

SUMMARY

The experimental and clinical experiences with tracheobronchial reconstructive procedures have been reviewed. The requirements for success have been emphasized. Six cases illustrating the application of plastic reconstruction of the trachea and bronchi are presented.

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WATERPROOF PLASTER

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This paper presents the clinical use of two types of waterproof materials to be used for support. These materials are glass cloth and a resin; the other is a plaster of paris and a resin. Each has its own uses which do not conflict, except that both in many ways are superior to ordinary plaster of paris. Plaster of paris mixed with Melmac 405, resin and ammonium chloride, as a catalyst, will produce a light, hard, thin waterproof, non-irritant cast that can replace most of the uses of regular plaster.

The first material discussed is Orthoply, a glass cloth-resin material. Its use is limited to those places where shells, molds, casts and jackets are needed. This substance requires the preparation of a plaster of paris mold. After the mold is allowed to dry, its body contact surface is painted with water glass and filled to a depth of ¼-inch with a substance known as Orthoroc. This hardens in 15 minutes to form a very accurate mold that is extremely hard. Any rough spots can be quickly removed with sandpaper. The resin dope is poured onto this mold and two layers of glass cloth are fitted and rubbed into place. This hardens quickly and the new shell is stripped from the Orthoroc. The rough edges are trimmed. It is fitted to the patient with either an elastic bandage or buckles and straps (figs. 1, 2).

This plastic style of cast or brace material has found wide clinical use. It is good and is used a lot for the socket or bucket of artificial limbs. The reason is that a very accurate fit to the skin can be obtained. Also, it is light, waterproof and durable. Its tensile strength can be controlled by the number of layers of glass cloth incorporated. Two layers is the usual number, and this makes the material extremely thin, but strong enough for most uses. Three layers of cloth make it quite hard and seldom are four layers ever needed for any clinical use. Scoliotic or kyphotic body jackets for the growing child are excellent. The child may even go swimming in a nonpadded jacket, without harm to himself or his jacket. Molded splints for paralyses, post-poliomyelitis, of the intrinsic hand muscles are especially excellent. For example, these would be opponens pollicis or lumbricales splints. Cock-up splints for the forearm and hand are good.

Of course, single or double hip spica shells are very good. Many Lucite or clear plastic molded shells have been tried in this study. While waterproof and non-irritant to the skin, the Orthoply is so

much stronger that it will not break up nearly so quickly, especially with an active, hard-to-control child.

The inventors of Orthoply were not satisfied as it required the intermediary step in the preparation of a support. Dr. Harold E. Weaver, of the Sarah Mellon Scaife Foundation's Multiple Fellowship on Orthopedic Appliances of Pittsburgh, Pa., and his coworkers, looked for a better material and came up with the first real advance in the use of plaster of paris since the invention of the so-called Specialist plaster.

Fig. 1

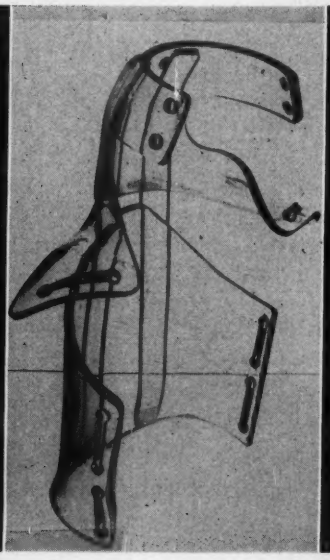

Fig. 2

Fig. 3

The material that is known as Melmac 405 is used in making some plywoods, to glue the pieces of wood together. This bond between the parts of wood is strong and waterproof. In making casts a 30 per cent solution of Melmac 405 has been found to be the most successful. This is activated by adding 3 per cent ammonium chloride. In other words, to the 1000 cc. of water is added 300 Gm. of Melmac 405. This is stirred to make a smooth, concentrated solution and is stable for many days. When ready to use, 30 Gm. of ammonium chloride is added, stirring it in slowly. The ordinary plaster of paris bandages or so-called Specialist plaster bandages are used. The bandages are merely soaked in this solution instead of in water. No gloves are needed to protect the skin. The plaster is applied to the patient in the routine way. The better

the plaster is rubbed as it is applied, the stronger, the smoother and prettier the cast. Only one-half the normal number of plaster of paris bandages are required. The Melmac plaster appears to be more than twice as strong as the plaster of paris. A thin light cast is formed, either in contact with the skin, or over stockinette, felt or cotton. It has, when rubbed well, a marble-like appearance. When thoroughly dry, it can be cut only with the electric cast cutter. Water will not soften the plaster. A 1000 cc. solution of Melmac 405 and ammonium chloride is sufficient to wet enough plaster bandages for a large adult body cast. The ease with which this cast is prepared cannot be overemphasized. There is less actual work than in the regular plaster cast as the cast is thinner and fewer rolls are used. In like manner, for all practical purposes, the cast dries as quickly as regular plaster (fig. 3).

Casts such as body jackets for scoliosis, hip spica shells for patients with anterior poliomyelitis and frog-leg spica cases for congenitally dislocated hips are the types of casts that have been most frequently used in the study. The body casts in some cases were bound and fitted with lacings or straps. The hip spica shells and long leg shells were put on as whole casts and bivalved. They were reapplied to the patient with elastic bandage. Forearm casts for fresh and old fractures have been tried and all found to be just the same as the regular plaster of paris cast, except they were thinner, lighter, stronger and waterproof. Water standing in a Melmac plaster form for some time can be made to pass, but the cast will not soften or become wet or lose its strength.

Out of one year's trial with plaster of Paris treated with Melmac 405 which would represent approximately 700 casts, three possible local contact allergic dermatitis cases have developed just before publishing this paper. Sensitivity to adhesive tape may be the cause and not the type of plaster.

The author wishes to thank Col. Spitler of Walter Reed General Hospital for introducing him to this material and permitting the clinical trials at the Georgetown University Hospital and Children's Hospital.

NECROTIZING FASCIITIS

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ALTHOUGH necrotizing fasciitis, since the Civil War, has been recognized as a dangerous infection, and called by many names (gangrenous erysipelas, necrotizing erysipelas, hospital gangrene, and hemolytic streptococcic gangrene), it has been considered a rare disease in the United States. The term, necrotizing fasciitis, is preferred to the other descriptive names because fascial necrosis is the most consistent manifestation of the disease. Most of the papers written about necrotizing fasciitis are case reports of 1 to 4 patients. The largest series heretofore was reported in 1924 by Meleney;[1] this was a group of 20 cases which had been observed in China. In 1929, Meleney stated that in the preceding four years he had seen only 7 cases of hemolytic gangrene at Presbyterian Hospital in New York and only 4 cases at other hospitals in New York.

In the three year period from 1948 to 1951, we have diagnosed and treated 22 cases of necrotizing fasciitis at Parkland Hospital in Dallas. One patient who was treated in a private Dallas hospital is included in this series, making the total 23. Six other persons with necrotizing fasciitis have been seen during this period, but their charts are either unavailable or unsatisfactory for analysis; therefore they are not included in this report. The reason for this large number of cases is not obvious. It might be said that such an inordinate number of necrotizing infections is a reflection of the inadequate isolation and sterile technics used in that hospital; however, 16 of the 22 patients from one hospital were suffering from necrotizing fasciitis at the time of admission. Perhaps the increased incidence is only apparent in that the house physicians have been taught the clinical signs and the methods of establishing the diagnosis of this infection; hence the number of recognized cases has increased. In the past, necrotizing fasciitis was often mistaken for cellulitis or erysipelas and treated conservatively; then ultimately the disease progressed to gangrene of the skin and the diagnosis was made of "wet" gangrene, for which amputation was often performed without recognition of the true disease. A review of our data reveals that there are some differences with Meleney's original observations. These differences may represent a modification of

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Presented during the St. Louis Assembly of The Southwestern Surgical Congress, Sept. 25-26, 1951, St. Louis, Mo.

the disease over a 27-year period; therefore, a comparative treatment of data is given in those instances in which the disease, as we observed it, is at variance with the older observations.

Etiology. The name previously given to this disease, hemolytic streptococcic gangrene, was derived from the fact that a hemolytic streptococcus was cultured in each of the 20 original cases. Hemolytic organisms were found in pure culture in 58 per cent of our cases that were studied bacteriologically, and were present with non-hemolytic bacteria in 26 per cent. Four of the cases did not have bacteriological study because the specimens were either lost or permitted to dry out. Cultures from 3 cases failed to grow out hemolytic organisms; however, in each instance these cultures were taken from an open wound abscess. It is well established that the hemolytic bacteria may not be cultured from open secondarily contaminated wounds, but are usually found in the areas of fascial necrosis. Anaerobic bacteria were found in only 2 individuals, and in them the anaerobes were inconsistently present. Whereas, the hemolytic organisms found in Meleney's series were streptococci in all and staphylococci in only 10 per cent, the hemolytic bacteria found in our cases were staphylococci in 88 per cent. According to these findings, the term hemolytic streptococcic gangrene is not appropriate.

Course. Necrotizing fasciitis may start in an operative wound, in a trivial injury (spider bite, insect bite, small abrasion or contusion), or may appear spontaneously. The course of the infection may be so fulminant that it involves an entire extremity in 24 hours (case 7); or it may remain dormant for weeks and then suddenly spread rapidly (case 22); or the infection may be slowly progressive for several weeks (case 14).

It is of value to recognize these variations in the rate of development of necrotizing fasciitis because the disease follows no typical temporal plan. All the patients were acutely ill and we were fearful that 10 might die.

The mortality of necrotizing fasciitis varied between 20-50 per cent two decades ago.[2] In this series two deaths occurred, a mortality of 8.7 per cent. In each instance there were concomitant illnesses. The death in case 28 followed a gunshot wound of the upper abdomen attended by severe irreversible hypotension of 72 hours' duration. The death in case 23 occurred 12 hours after the patient was admitted to the hospital in coma. Postmortem examination revealed a dilated heart, pulmonary edema and hyperemia, portal cirrhosis, bilateral pleural effusion, ascites, and esophageal varices.

Evaluation of Diagnostic Signs. Some of the older descriptions of the disease list cutaneous gangrene as a universal accompaniment. Reference to table 1 indicates that this does not obtain in

TABLE I

Skin Changes Accompanying Necrotizing Fasciitis

	1924 series (% of patients)	Current series (% of patients)
Gangrene	97.4	48*
Erysipelas[2]	6	43**
Subcutaneous and fascial necrosis	100	100

*Individuals who had any necrosis or dissolution of skin are included.

**Erysipelas was diagnosed if an area of skin was edematous and hyperemic with sharp delimitation. The individuals having diffuse skin redness and swelling with poorly defined edges are not included in this figure.

this series, and in addition it is seen that erysipelas was at one time infrequent but is now a cutaneous manifestation of necrotizing fasciitis nearly as often as gangrene. Cellulitis, a diffuse hyperemia and swelling of the skin, attended the fascial infection in an additional 39 per cent of these patients. If the course of the disease is unaltered by surgical intervention, blisters will appear in the skin in the area of the cellulitis or erysipelas. These blisters are usually filled with reddish-black fluid, and soon after their formation the skin underlying the blister becomes necrotic and black. This localized necrosis is due to thrombosis of the nutrient vessels of the skin as they pass through the zone of fascial necrosis. Thus gangrene of the skin is an inevitable consequence of the progress of necrotizing fasciitis and will occur in spite of the fact that the individual is receiving antibiotic therapy—5 of the 11 patients in this series having gangrene had received antibiotics during the development of the infection. Even though gangrene will eventually appear in nearly all instances of this disease, its late development in most individuals detracts from its diagnostic value. To wait for the development of gangrene before treatment is instituted in this disease is like waiting for a deep cervical abscess to point before it is incised.

One of the skin changes seen in necrotizing fasciitis is widespread ecchymosis which is illustrated in figures 1 and 2 and described in case 1. In both of these cases the observation was made by the surgeon that the subcutaneous veins were thrombosed and the arteries were patent—an excellent predisposition to ecchymosis, particularly with bacterial proteolytic enzymes disrupting vessel walls.

One of the earliest descriptions of hospital gangrene written by

Joseph Jones, a Confederate Army Surgeon, in 1871, depicts this skin discoloration. For example, Jones wrote: ". . . a purple or blue spot is first perceived. . . . The cuticle is sometimes raised, and contains serum below. . . . I have seen the skin in the affected spot melt away in 24 hours, . . . whilst a deep blue and purple, almost black, areola surrounding the dead mass, spreads rapidly in ever increasing circles. . . . This is witnessed most generally in the worst and fatal cases."[3]

Fig. 1. Case 1 (9-5-50). After necrotizing fasciitis was discovered, incisions were made wherever the subcutaneous undermining extended. Note the ecchymosis of the skin overlying the necrotic fascia.

Fig. 2. Case 1 (9-5-50). The blue-black ecchymosis followed the necrosis around the back. The incisions fell short of the periphery of the discoloration and subsequently had to be extended.

The most dangerous type of fascial infection is the one which is disguised behind a simple edema of the skin with little or no cellulitis, erysipelas, ecchymosis, or gangrene. Most of the involved area in figure 7, case 13, demonstrates this dangerous type. Note the benign appearance of much of the overlying skin.

The variable skin manifestations make diagnosis by inspection sometimes hazardous, and corroborative evidence is needed. If the skin that is involved is hypesthetic or anesthetic to pin prick, the likelihood of an underlying fasciitis is great (table 2). This is evidence that the cutaneous nerves have been involved in the necrosis of the subcutaneous fascia.

TABLE II

Patient			Day of disease* on admission		Initial injury	Site of infection	Antibiotic during development	Gangrene	Subcutaneous and fascial necrosis	Diminished sensation pin prick	Cellulitis	Erysipelas	Maximum fever (F.)	Minimum hemoglobin (Gm. per 100cc.)	Jaundice	Critically ill	Bacterial studies**				Day of disease operated on	Total hospital days
Number	Sex, age	color		mo. of yr.													Hemolytic bacteria only	Hemolytic and non-hemolytic	Non-hemolytic	No culture		
1	36	W M	6	9	appendectomy	abdomen chest back scrotum	+	—	+	+		—	103	9.8	+	+		+ sta.			6	36
2	34	C M	3	2	puncture wound	arm	+	—	+			+	104	10.5						+	3	15
3	29	C M	7	6	stab	arm		—	+			+	102	11.5						+	7	21
4	27	C M	4	3	gunshot laparotomy	abdomen	+	—	+	+		—	104	5.	+	+			+		4	59
5	50	LA F	14	5	fingernail scratch	abdomen		—	+	—	+	—	99.8				+ sta.				14	11
6	54	C F	3	4	abrasion	leg		+	+	+	+	—	none	11.			+ sta.				3	8
7	25	C M	14	2	stab	leg buttock	+	—	+	+	+	—	104	10.5			+ sta. str.				14	27
8	42	C M	1	4	laceration	arm		—	+	—	+	—	105	10.						+	1	22
9	38	C F	9	6	insect bite	leg	+	—	+	+		+	102	9.5				+ sta.			9	24
10	60	C F	7	3	none	labia abdomen	+	+	+		+	—	101	10.				+ sta.			7	16
11	76	W F	4	9	spider bite	leg		+	+	—		+	101.8	10.			+ sta.				4	28
12	67	W M	10	10	contusion	leg		+	+	+		+	101.4	5.8	+	+	+ sta. str.				10	69

TABLE II Continued

Patient			Day of disease* on admission		Initial injury	Site of infection	Antibiotic during development	Gangrene	Subcutaneous and fascial necrosis	Diminished sensation pin prick	Cellulitis	Erysipelas	Maximum fever (F.)	Minimum hemoglobin (Gm. per 100cc.)	Jaundice	Critically ill	Bacterial studies**				Day of disease operated on	Total hospital days
Number	Sex, age	color		mo. of yr.													Hemolytic bacteria only	Hemolytic and non-hemolytic	Non-hemolytic	No culture		
13	28	W M	5	6	appendectomy	abdomen scrotum	+	+	+	—	+	—	103	9.7	+	+			+		6	29
14	63	C M	30	10	splinter	leg		+	+	—		+	103.4	9.5	+		+ sta. str.				30	28
15	60	W M		1	unknown	leg	+	+	+	+		+	102.2	10.5	+	+	+ str.					29
16	80	C M	14	5	none	leg	+	+	+	—		+	104	10.	+		+ sta. str.				16	67
17	65	W M	10	11	contusion	leg		+	+	+		+	100	9.5			+ sta. str.				10	59
18	31	LA M	1	9	gunshot laparotomy	abdomen	+	—	+	+		—	102			+				+	1	3 (died)
19	22	C M	4	9	gunshot laparotomy	abdomen thigh	+	—	+	+	+	—	105	10.		+		+ sta.			4	57
20	45	C F	14	7	none	vulva, ab., thigh, back	+	+	+	+	+	—	105	8.	+	+			+		14	62
21	52	W M	9	7	puncture wound	arm		—	+	+		+	101	12.			+ str.				9	13
22	46	C F	20	10	nephrostomy	retro-peritoneal	+	—	+	—		—	102.8	7.5	+	+		+ sta.			21	37
23	54	W M		11	unknown	leg		+	+	+	+	—				+	+ sta. str.					1 (died)
Total							13	11	23	13	9	10			9	10	11	5	3	4		

*If disease developed in a hospital patient, the day of diagnosis is indicated.

**Abbreviations: Sta. = staphylococcus; Str. = streptococcus.

None of the above signs is infallible for determining the presence of necrotizing fasciitis. The pathognomonic feature of the disease is subcutaneous and fascial necrosis which is manifested by extensive undermining of the skin. This sign of the disease has not changed in its constancy since 1924 (table 1). If there is an opening in the skin, one can ascertain the presence and extent of undermining by passing a probe or hemostat through the opening and along the plane just superficial to the deep fascia, as illustrated in figure 7. In cellulitis or erysipelas without necrotic fascia an instrument will not follow this subcutaneous plane. If no skin opening is present through which the probe can be passed, an incision should be made through the skin to determine whether undermining exists. When undermining is found, immediate surgical treatment is indicated. One should not wait for laboratory confirmation of the presence of hemolytic organisms.

Fig. 3. Case 1 (9-5-50). The extensive surgical undermining that is necessary to expose the necrotic fascia leaves large skin flaps—some of these flaps were reflected to show their extent.

Fig. 4. Case 1 (9-11-50). The large black skin flap fashioned on the back by the surgical undermining looks as if it might be necrotic. Figure 6 shows its ultimate fate. The white material is gauze impregnated with activated zinc peroxide.

Treatment. Long ago the discovery was made that the only effective treatment for necrotizing fasciitis is incision for the entire extent of involvement. To postpone surgery and use massive doses

of antibiotics is ineffective and, in addition, the incision which must eventually be made must then be more extensive in a sicker patient. Thirteen of the 23 patients suffered progression of their infections while receiving antibiotics (penicillin, streptomycin, chloromycetin, aureomycin, sulfadiazine) when no incision or an inadequate incision had been made. Figures 3, 4, 8, 9 and 13 are illustrative of the extensive incisions that often must be made in order to stop the relentless progress of necrotizing fasciitis. One can tell when the incision is adequate by the fact that an instrument or finger can no longer separate the skin and subcutaneous fascia from the deep fascia. Circumferential fascial necrosis of extremities must be undermined bluntly by the operator's hand. The appearance of the subcutaneous tissue is characteristic. Although the infected area is edematous and thin, sanguineous, turbid fluid exudes from the incised fat and fascia, purulent accumulations are not commonly found except at the site of the initial injury. The subcutaneous fat is necrotic; the superficial fascia and the superior surface of deep fascia are stringy, ragged, and gray—occasionally hemorrhagic. There are usually a few firm gray fibrous strands running between the deep and superficial fascia which do not break easily with blunt undermining—these are arteries and should be left unbroken if the undermining has to include more than one-half the circumference of an extremity. The skin losses from such extensive procedures have in most cases been minimal. Two elderly patients, 80 and 76 years old, had a slough of the skin flaps which had been isolated on the leg by parallel longitudinal incisions, but the defects were entirely covered with split-thickness skin grafts. Split-thickness skin grafting can be successfully performed when the slough is separated and the evidences of infection are absent, or if new epithelium grows from the edges of the wound. Ten days was the shortest interval after incision that skin grafting was done. In many wounds, secondary closures can be accomplished. Early attention to apposition of the wound edges obviates extensive grafting procedures.

The antibiotic that was used in every person was penicillin—usually in doses of 100,000 units every three hours.

In the severely ill individuals or those in whom spread of the necrosis continued after the initial surgical opening, additional antibiotics were used. Emphasis is made of the fact that amputation of a limb was not necessary in any of the patients. Since the necrosis characteristically remains superficial to the deep fascia (unless the original injury penetrates that layer) amputation is rarely warranted.

Locally, the wound was loosely packed with gauze which had

been impregnated with activated zinc peroxide and the wounds were kept moist with a constant saline drip. When activated zinc peroxide was not available the wounds were packed open with gauze and a constant saline drip used.

Fig. 5. Case 1 (12-6-50). Split-thickness skin grafts were applied three weeks after the initial incision. This photograph was taken after discharge from the hospital.

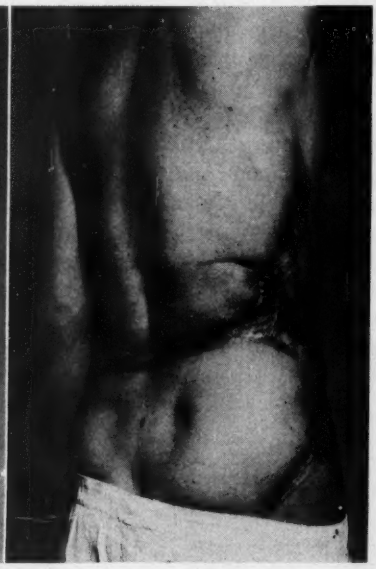

Fig. 6. Case 1 (12-6-50). The losses of skin from the extensive flaps were minimal. The areas of granulation tissue between the flaps required grafting, as shown above.

Many of these persons are critically ill as a consequence of the physiologic derangements which are incident to the necrotizing infection. The derangements may be legion but those commonly encountered are summarized:

1. Extracellular fluid volume deficits may be severe even though no external losses of fluids occur. The massively edematous leg described in case 12 was measured and, by comparison with the normal leg, was computed to have an excess of 3 L. of extracellular fluid sequestered in it. As a consequence of this deficit of salt water, he was stuporous. Replacement of the lost volume with intravenous Ringer's-lactate solution was attended by marked improvement in sensorium. External salt water losses occur after surgical incision. Meleney describes apathy and somnolence as one of the features of necrotizing fasciitis that serve to differentiate it from streptococcic

cellulitis. Likely this is true because salt water deficits frequently attend necrotizing fasciitis.

2. Rapid destruction of red blood cells occurred as a result of the bacterial hemolysin. An anemia developed in 19 of these patients. The rapid rate of red cell destruction was attended by jaundice in 9 patients.

The loss of red cells is massive in those persons who develop subcutaneous ecchymoses. Additional blood can be lost in extensive subcutaneous venous thromboses, and functionally, blood is lost into the area of cutaneous hyperemia. Obviously whole blood transfusions are an important part of the treatment of necrotizing fasciitis and they should be given during the surgical incisions which may cause the spill of large quantities of blood.

Fig. 7. Case 13 (6-27-51). The five day old appendectomy wound is shown by the instrument in the subcutaneous plane to have extensive undermining about it even though the skin of the abdominal wall is relatively unchanged. Three small necrotic areas are present in the scrotum.

Fig. 8. Case 13 (6-27-51). The necrotic superficial fascia is shown after the incisions were made.

3. Ionic calcium deficits were made clinically manifest by muscular twitchings, hyperactive tendon reflexes, Chvostek's sign, and, in one individual, carpopedal spasm. It is thought that the calcium is sequestered in the area of fat necrosis. As a result of the fat

being split by bacterial lipase, ionic calcium can combine with fatty acids to form an insoluble soap.

Fig. 9. Case 13 (2-27-51). The necrosis extended across the lower abdominal wall to the left hip and flank and into the scrotum.

Fig. 10. Case 13 (7-11-51). Clean granulations appeared in two weeks. Split-thickness skin grafts were placed on the granulating wounds after this picture was made. The discoloration of the skin flaps is due to the use of silver nitrate (½ per cent) soaks.

Case 1. A 36 year old male was admitted to Parkland Hospital on Sept. 5, 1950, six days after having had an appendectomy. On his second postoperative day, an episode of hypotension was treated by the intravenous infusion of plasma and saline. At that time a bluish discoloration was present about the operative wound. The wound was opened but the soreness and discoloration progressed.

Physical examination: Recent open appendectomy wound in the right lower quadrant of the abdomen and spreading out in all directions to axilla, thigh, scrotum, back and flank was a purple bluish-black discoloration of the skin

Fig. 11. Case 13 (8-8-51). The healed area one month after grafting.

Fig. 12. Case 13 (8-8-51). Skin flap retraction, not skin necrosis, caused the defect which required grafting.

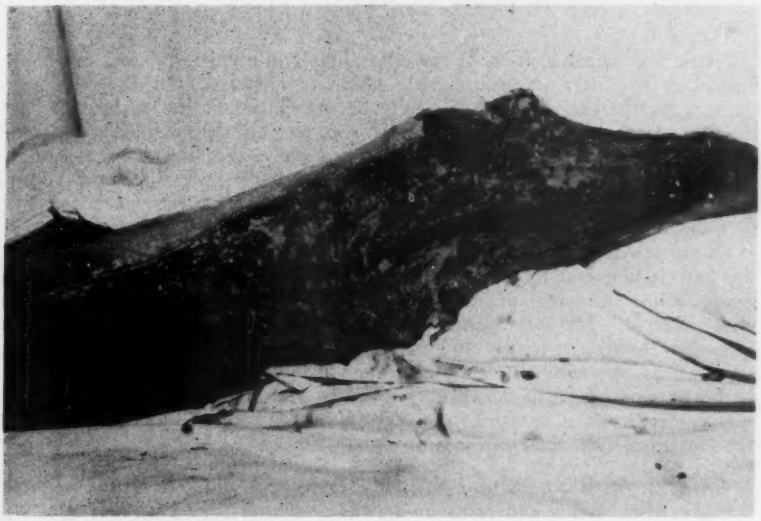

Fig. 13. Case 12 (10-19-48). Incision and surgical undermining of the skin had to be carried for the full length of the right leg and around the entire circumference at the knee. A longitudinal incision was made also on the medial aspect of the lower thigh, knee and upper calf in order to expose all the necrotic subcutaneous fascia.

which was edematous. One hemorrhagic vesicle was present in the skin near the wound. Massive undermining of the skin was found to extend in all directions from the wound.

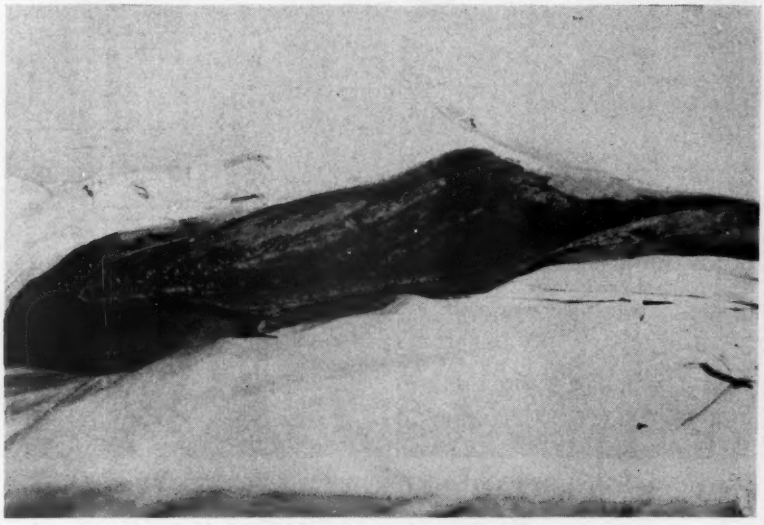

Fig. 14. Case 12 (10-29-48). Ten days later granulation tissue appeared and the signs of infection were subsiding.

Course: Surgical incision of the edematous and ecchymotic area was performed shortly after admission to the hospital (figs. 1, 2, 3). Necrosis was confined to the superficial fascia and subcutaneous fat; the surface of the external oblique aponeurosis was ragged, necrotic and hemorrhagic. No pus was found. Twelve hours after this first procedure, the disease was observed to have spread, so the patient was taken again to the operating room and a 10 cm. extension made of the initial incision. Within 48 hours another operation was necessary in order to expose the spreading fascial necrosis—a 21 cm. extension across the back, 15 cm. extension up to the right axilla, 7 cm. extension into ischiorectal fossa and scrotum (fig. 4). Massive amounts of intravenous saline solutions and whole blood had to be given to restore the daily losses thereof. He was given penicillin, aureomycin, chloromycetin, and eventually bacitracin locally and parenterally. The man was gravely ill for several days, but within 10 days the wounds were beginning to look clean and within three weeks split-thickness skin grafts were applied to the granulating surfaces. He was discharged five weeks after admission. The appearance of the grafted areas is shown in figures 5 and 6.

Case 13. B. T., a 28 year old white male, was admitted to the hospital five days after having undergone an appendectomy on June 19, 1951. He was pale, icteric, hyperirritable and irrational. Examination revealed swelling and redness about the recent appendectomy wound. Some redness extended into the scrotum, flanks, and thighs, but the edema extended farther. There were three small necrotic areas of skin in the scrotum (fig. 7). Undermining of the skin and superficial fascia was demonstrated and the entire area of involve-

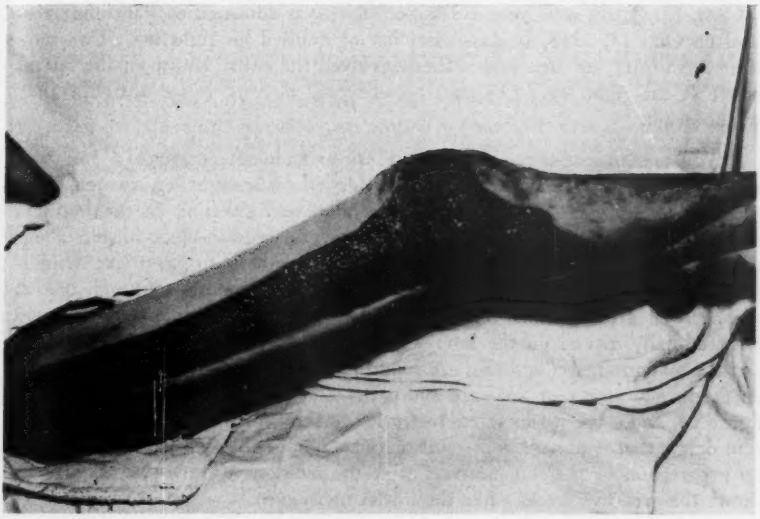

Fig. 15. Case 12 (11-11-48). No loss of skin occurred after the incisions were made.

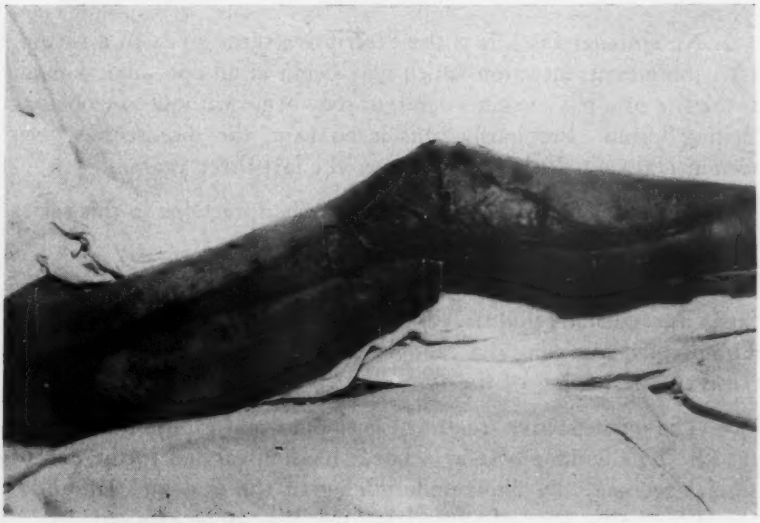

Fig. 16. Case 12 (11-21-48). The grafted wound is shown with the skin edges having healed after being brought closer together than in figure 15.

ment was incised (figs. 8, 9). It was necessary to extend the incision the following day. The area gradually became free of necrosis, granulations appeared (fig. 8) and skin grafts were applied two weeks later. One month later, the skin grafts appeared as shown in figures 11 and 12.

CASE 12. J. B., a 67 year old white male, was admitted to Parkland Hospital on Oct. 13, 1948, 10 days after having bruised his right leg. Two days after this injury, soreness and redness involved the entire length of the lateral aspect of the right leg. The pain became progressively worse until the time of admission.

Physical examination: The patient was somnolent, extremely pale and showed signs of extracellular fluid volume deficit. The right leg was massively edematous and red. The edge of the redness and swelling in the inguinal region was sharply delimited. There were several reddish-black blisters about the lateral aspect of the knee, and the leg was anesthetic to pin prick. Undermining of the skin was demonstrated by passing a hemostat through one of the necrotic areas of skin under a blister. The entire skin of the leg was longitudinally incised on the lateral aspect from hip to ankle and circumferentially undermined (fig. 13). A longitudinal incision also had to be made on the medial aspect of the knee and calf. The leg is shown 10 days later in figure 14, and three weeks later, just prior to skin grafting, in figure 15. The skin defect that is present is a result of retraction of the skin flaps. There was no progression of the skin necrosis after the incisions were made. Figure 16 shows the area five weeks after the initial incision.

SUMMARY

1. Necrotizing fasciitis is the descriptive term given to a severe, often fulminant, infection which may begin in an operative wound, at the site of a trivial skin wound, or may begin without any obvious inciting lesion. Previously considered rare, the disease has been seen in Dallas in 29 individuals over the last three years.

2. Bacteria most often cultured from the infections in this series were hemolytic staphylococci.

3. The various manifestations in the skin overlying the necrotic fascia are: edema, cellulitis, erysipelas, ecchymosis, bullae, gangrene. The diagnosis is clinically established by the demonstration of extensive undermining of the skin.

4. The only effective treatment is to open and expose the necrotic fascia. This is done best by a linear incision carried to the end of fascial necrosis. By blunt undermining of the skin and superficial fascia the entire area of necrotizing fasciitis can be exposed.

5. Many of the individuals suffering from necrotizing fasciitis are critically ill but the mortality has been minimized by early recognition of the infection, prompt surgery, penicillin, and particular attention to the correction of the physiologic derangements attendant to severe hemolytic infections.

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THE AMERICAN SURGEON

Official Publication of
THE SOUTHEASTERN SURGICAL CONGRESS
THE SOUTHWESTERN SURGICAL CONGRESS

Published Monthly by
The AMERICAN SURGEON PUBLISHING COMPANY
701 Hurt Building, ATLANTA 3

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Subscription in the United States, $8.00

Volume XVIII April, 1952 Number 4

GASTRIC ULCER AND CARCINOMA OF THE STOMACH

The benign gastric ulcer which fails to heal or which recurs after treatment should be considered a potential gastric carcinoma and it demands early surgery.

The recognition and early treatment of gastric carcinoma is such a serious problem and the five-year survival rate following radical surgical procedures for carcinoma of the stomach is so low that the physician needs to be constantly aware of the frequency of gastric carcinoma, particularly in the male. It is evident that radical surgical procedures for advanced carcinoma of the stomach result in a distressingly low salvage rate and it is exceedingly important to look for early signs and symptoms that indicate precursors of gastric carcinoma. It can be said definitely that gastric ulcer is a precursor of gastric carcinoma. Over the years, conservative treatment with dietary and medical means has been employed in a large enough series of cases of benign gastric ulcers in which gastric carcinoma later developed to make one certain that gastric carcinoma can and does arise in the chronic gastric ulcer. How high this percentage is cannot be stated definitely; in all probability, it is not high. The inci-

dence of gastric ulcers that remain unhealed and that may ultimately become gastric carcinomas has been conservatively estimated to be between 5 and 10 per cent and probably higher.

More important than the development of carcinoma in gastric ulcer is the fact that small ulcerocancers of the stomach are frequently mistaken for benign ulcers and treated for long periods by dietary methods and thus the opportunity is lost for cure with surgery when the tumor is at an early stage. In a group of 131 patients at this clinic who came to surgery with the preoperative diagnosis of benign gastric ulcer, 26 had gastric carcinomas, an incidence of 19.8 per cent. In 1939 Finsterer reported a cancer incidence of 20.9 per cent in a group of patients with chronic gastric ulcers who were treated by operation. Welch reported the incidence of malignant gastric ulcers to be 14 per cent. In a study of 600 patients with treated gastric ulcers, 270 of whom were operated on, Smith and Jordan of this clinic found ulcerocancers in 59. It is a disturbing matter that when many patients with chronic, benign gastric ulcers ultimately come to surgery, malignant disease is found in a fairly large percentage.

The age of the patient, the location and size of the gastric ulcer do not give a trustworthy indication of its benignity. In our group of 131 patients who came to operation and who had chronic, benign gastric ulcers, the average age (54 years) closely approximated the average age of patients with gastric carcinoma.

The location of the ulcer in the stomach is of no value in helping the internist or the roentgenologist to make the decision as to whether the ulcer is benign or malignant. It is true that a small gastric ulcer on the lesser curvature in a young individual in all probability is benign. Not all ulcers in the antral or prepyloric region are malignant and benign ulcers may be found in this area, although one should be more suspicious of a chronic ulcerating lesion in the antral area. Almost all gastric ulcers of the greater curvature are malignant and at the clinic we have had only 6 cases of benign ulcer on the greater curvature of the stomach. We have been prone to accept statements from the literature that an ulcer over 2.5 cm. is most certainly malignant. We have seen ulcers much larger than 2.5 cm. which, in 25 per cent of the cases, were benign, and we have seen many malignant ulcers of the stomach much smaller than 2.5 cm.

If patients with gastric ulcers are to be treated with diet and medication, we must be absolutely certain that the ulcers heal and remain healed. In other words, a mucosal defect must be completely epithelialized and this must be demonstrated on several occasions

by either roentgenogram or, if possible, by gastroscopic examination. If, within a reasonable period, three weeks, the ulcer recurs or fails to heal, operation should be performed immediately.

In the hands of an experienced surgeon, the mortality of gastric resection for chronic gastric ulcer is extremely low and should be less than 2 per cent. Mortality of patients who have unrecognized carcinomas of the stomach who are treated by a medical regimen is 100 per cent.

Undoubtedly, the curability of gastric carcinoma depends almost entirely upon early recognition of the gastric neoplasm. Chronic gastric ulcers are precursors of cancer. The physician and surgeon should be aware of the grave difficulty in distinguishing between a malignant and a benign ulcer and resection should be promptly performed if the ulcer fails to heal. Only by recognizing the danger of gastric ulcers will patients be brought to surgery early and the curability rate in gastric cancer be increased. An increasing number of patients with gastric ulcers must be submitted to surgery if we are going to improve our results in the treatment of gastric carcinoma.

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BOOK REVIEWS

The Editors of THE AMERICAN SURGEON *will at all times welcome new books in the field of surgery and will acknowledge their receipt in these pages. The editors do not, however, agree to review all books that have been submitted without solicitation.*

ATLAS OF GENITO-URINARY SURGERY. By PHILIP R. ROEN, M.D., F.A.C.S., Instructor in Urology, New York Postgraduate Medical School; Clinical Instructor in Urology, New York Medical College. New York, Appleton-Century-Crofts, Inc., 1951. 325 pages. 429 illus. $8.00.

This volume fills a definite need as an illustrative text of fundamental genito-urinary surgery. Original, simple line drawings with brief explanations are used to illustrate each step in all of the commonly used urologic surgical procedures. Standard technics are generally employed, but significant variations in certain procedures are also given. No attempt is made to cover the indications for or the general principles of urologic surgery, nor of many of the numerous infrequently used operations. The usual types of traumatic urologic surgery are included as are most of the recently introduced improvements in approach and technic, such as transthoracic nephrectomy, retropubic prostatectomy and mucosa to mucosa ureterosigmoidostomy. Some diagnostic procedures are described, including perirenal air insufflation, with the omission of translumbar arteriography as the most notable defect.

This author's contribution will be quite valuable as a quick, simple reference on surgical technic for those engaged in urologic training, for surgeons doing urologic work infrequently and for review by practicing genito-urinary surgeons.

BITHEL WALL, M.D.
J. M. ECHOLS, M.D.

A HISTORY OF NEUROLOGICAL SURGERY. Ed. by A. EARL WALKER, M.D. Baltimore, The Williams and Wilkins Company, 1951. 583 pages. $12.00.

Under the ever constant stimulus of Dr. Walker, this volume is a direct outgrowth of seminars from the Division of Neurological Surgery of Johns Hopkins University. The material presented proved so absorbing that the essayists decided, fortunately, to collect the material into a monograph. As a result, this is a volume whose content is fascinatingly readable and still capable of acting as authoritative source material. As always, an amazing store of still useful and practical material applicable to present day surgery is uncovered by medical historical research. This is quite true in this particular instance. The book is abundantly and well illustrated and is delightful and entertaining, and will be a useful addition to one's library, regardless of his clinical preferences.

ROBERT F. MABON, M.D.

Books received are acknowledged in this section, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

CALLANDER'S SURGICAL ANATOMY (Third Edition). By BARRY J. ANSON, M.A., Ph.D. (Med. Sc.), Professor of Anatomy, Northwestern University

Medical School, and Walter G. Maddock, M.S., M.D., F.A.C.S., Elcock Professor of Surgery, Northwestern University Medical School. Philadelphia, W. B. Saunders Company, 1952. $14.00.

RUPTURES OF THE ROTATOR CUFF. By H. F. MOSELEY, M.A., D.M., M.Ch. (OXON), F.R.C.S. (ENG. & C.), F.A.C.S., Hunterian Professor, Royal College of Surgeons of England, Assistant Professor of Surgery, McGill University Associate Surgeon, Royal Victorian Hospital, Montreal, Quebec, Canada. Illustrated by Helen MacArthur. Springfield, Charles C Thomas, 1952. $6.50.

MONOGRAPHS ON SURGERY 1952. By B. NOLAND CARTER, M.D., Ph.D., Editor, Professor of Surgery, University of Cincinnati, Director of the Surgical Services, Cincinnati General Hospital. Advisory Editors, Joe V. Meigs, M.D., Clinical Professor of Gynecology, Harvard University Medical School, Chief of the Vincent Memorial Hospital; Charles Huggins, M.D., Professor of Urology, the University of Chicago, Chairman of Committee on Cancer, the University of Chicago; Alfred R. Shands, M.D., Medical Director, Alfred I. duPont Institute ot the Nemours Foundation. Baltimore, The Williams and Wilkins Company, 1952. $12.50.

FRACTURES AND JOINT INJURIES. By SIR REGINALD WATSON-JONES, B.Sc., M.Ch.Orth., F.R.C.S., F.R.A.C (Hon.), F.A.C.S. (Hon.), Volume I, Fourth Edition. Baltimore, The Williams and Wilkins Company, 1952.

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